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THE MODEL ENGINEER

The MODEL ENGINEER

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24TH JULY 1952 VOL. 107 NO. 2670

SMOKE RINGS

Our Cover Picture

● THERE has recently been a brisk exchange of views in our "Practical Letters" columns regarding modern tendencies in the design of model speed boats, and many readers, therefore, will probably be interested in this photograph of Mr. George Lines, of Orpington, with his latest "A" class boat *Big Sparky*. This follows fairly closely the design of his earlier "B" class boat *Sparky II*, which was described in THE MODEL ENGINEER about six months ago, and around which the above discussion mainly centred. These boats certainly embody principles, which, if not definitely revolutionary, are at least the result of original and individual thought. The primary intention, we understand, in using a narrow "fuselage," with the sponsons that form the main planes separated from it by a substantial air space, is to reduce the effect of air lift, which often causes boats to leave the water, or turn a backward somersault, at high speed. Although the boats have not been entirely free from trouble, whether from this or other causes, their improved stability has been sufficiently marked to induce several other constructors to adopt similar principles of design.

The universal adoption of the two-point tether and the surface propeller have upset nearly all the older theories of racing hull design, and constructors have to explore entirely new fields in coping with changed conditions. It may be said that there are absolutely no established data on hull design for boats intended to run at unprecedented speeds; experience is the only guide, and designers are quite justified in experimenting with what the orthodox boat designer would regard as freaks. Criticism of the designs comes mainly from people who have never attempted to produce high-speed craft, and have no practical idea of the problems to be encountered.

Mr. Lines started his model speed boat career as an exponent of flash steam, and encountered all the trials and tribulations which seem to be inseparable from this form of motive power. His most consistent success has been obtained with two-stroke engines of 15 and 30 c.c., and it may be said that no less ingenuity has been shown in the design of these than in the hulls. One of his noteworthy experiments has been the application of paddle wheels to model racing craft, and though these have not been a complete success, the efforts spent on them have certainly not been wasted.

The "Super Lions"

● AMONG the many letters we have received from readers who were interested in our note published in the issue for July 3rd, we were delighted to find one from Mr. E. A. Lucas of Salisbury,

who is, as he says, "the proud owner of No. 19782, *Lion*." He expects that our traction engine enthusiasts will be pleased to know that this engine is not rusting away, but is licenced and in use; in fact, she has just returned from a 50-mile journey. Mr. Lucas believes her to be the finest engine in the country, because she is a well-kept, modern engine, in beautiful condition and complete, just as she was turned out by Fowlers in 1932. He bought her from Anderton and Rowland, who had her when new, because she was likely to stay in their yard and rust away, and he wanted to save her and, of course, preserve her. Mr. Lucas adds: "If any of your readers would like to see her in steam, they should drop a line to E. A. Lucas, 20, Norfolk Road, West Harnham, Salisbury, Wilts, as I always make steam fans welcome."

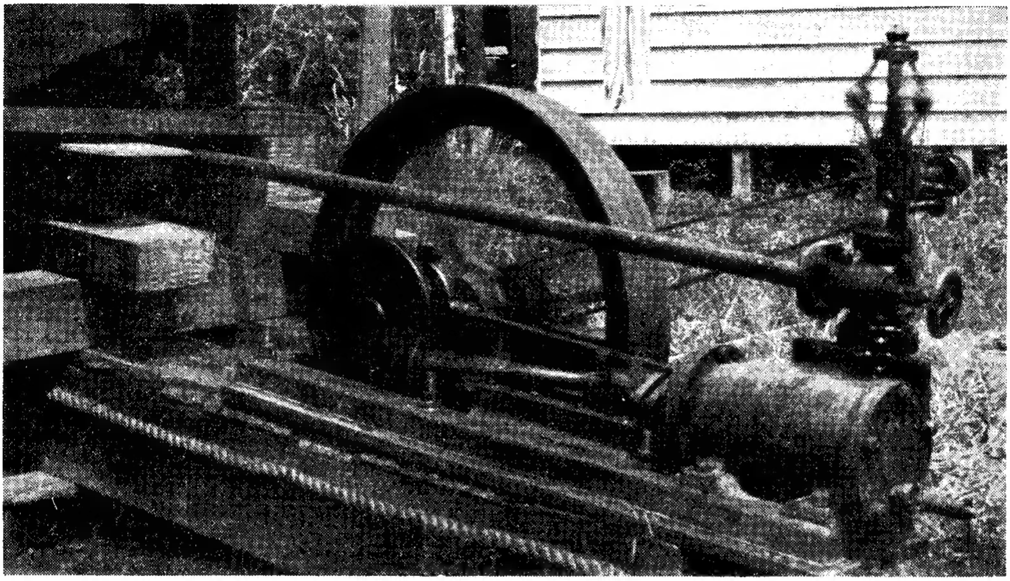
Mr. H. J. Barker, hon. secretary of the British Fairground Society, and several other readers tell us that No. 19783, *King Carnival II*, is now owned by Thompsons Boiler Works Ltd., Wolverhampton, and used as a crane engine. No. 19989, *Onward*, was broken up for scrap about the end of 1949. So now we know definitely what has happened to all four of the "Super Lions."

Mr. Barker, by the way, states that he is able to supply details of nearly four hundred Fowler engines which were either built for or, after conversion, used by Showland owners; the information has been passed to him by Mr. Alf Pepper, who has spent nearly 58 years with the celebrated Leeds firm. If any reader is interested, Mr. Barker's address is 23, Quick Road, Chiswick, W.4.

Steam from the Earth

● MR. D. A. ANSON, of Wellington, New Zealand, has sent us the interesting photograph reproduced on this page. The old mill engine has been harnessed to a steam supply generated in the earth, and is situated at the Spa Hotel, Taupo, New Zealand.

A shaft was sunk 225 ft. into the ground from which issues natural steam at a pressure of 60 lb. per sq. in. The engine is used to supply some four kilowatts of electrical energy for the hotel. So far as the boiler is concerned it is estimated steam will be available for the next million years



at a cost of £350 for sinking the bore. It is claimed that the only other places to have used geothermal steam in this way are in Italy and Mexico. The New Zealand Government is investigating the possibility of generating 100,000 kilowatts in this manner, but the photograph depicts a private enterprise venture that has proved a success.

"The Miniature Locomotive"

● WE HAVE received a copy of the first issue of the new American bi-monthly magazine, *The Miniature Locomotive*, and we find a bright, refreshing and pleasing publication devoted entirely to live steam and primarily to small locomotives.

It is profusely illustrated and the articles range from a description of Walt Disney's "Carolwood-Pacific Railroad," an elaborate $7\frac{1}{4}$-in. gauge railway based on old-time practice, to the description of a mechanical lubricator for use on a $\frac{3}{4}$-in. scale locomotive. Mr. Lester D. Friend, president of New England Live Steamers, contributes the first of a series of articles describing complete locomotive construction in 1-in. scale. Club news is given much prominence and provides a great deal of interesting reading.

We like the whole style of production; it is friendly, chatty and, above all, useful, just the sort of thing that is likely to enhance the popularity of live steam as a source of power for locomotives and engines of most kinds.

The Shepherd Electric Clock System

by H. R. Langman

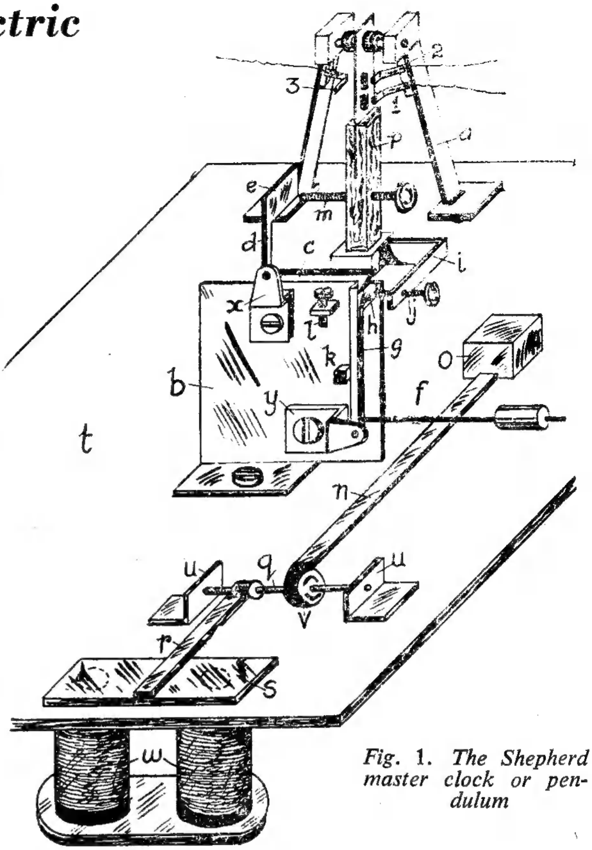


Fig. 1. The Shepherd master clock or pendulum

IN the year 1849, Charles Shepherd patented a new method of maintaining the vibration of a pendulum by employing an electromagnet to raise a weighted or gravity arm which was then retained in the elevated position by a catch or detent.

During the swing of the pendulum in one direction the detent was lifted, the gravity arm, now being free to fall, imparted an impulse to a pallet carried by the pendulum.

The pendulum also controlled current for energising an electromagnet to reset the gravity arm.

Two other contacts, one on each side of the pendulum, were alternately engaged by the pendulum for transmitting currents to operate the "impulse" or secondary clocks.

So much for the general principle of the system; now it is proposed to describe some of the mechanical arrangements of the system, commencing with the electric master clock or transmitter shown in Fig. 1.

A table or baseplate *t*, has mounted on its remote end a substantial A-shaped standard *a* to support the seconds pendulum *p*, the suspension spring of which is secured in the approved manner of that day. Mounted in front of the pendulum is a bracket *b* carrying the working parts, consisting of a detent or catch *c* supported in an outer bearing *x*; an arm *d* extending upwards terminates in a projection *e*, which is engaged every other swing by a screw *m* carried by the pendulum. A screw *l* gauges the drop of the member *c*.

Situated below *c* is a vertical gravity arm *g* pivoted in the bearing *y*. Integral with *g* and extending horizontally is a light rod *f*, the latter being provided with a small balance weight. The arm *g* has also a projection *h* engaged by a screw *j*, carried by the impulse pallet *i*, attached to the pendulum rod *p*.

Movement of *g* to the left is limited by a stop *k*. The rod *f* is engaged and raised by a long lever *n* attached to a boss *v* mounted on an arbor *q*, the arbor being in turn supported in small brackets *u*.

Also mounted on the arbor *q* is an arm *r*, the outer end of which is attached to a soft-iron armature *s*. A small weight *o* controls movement of lever *n*.

Secured to the bottom face of the table *t* is a double-coil electromagnet *w*, the poles protruding through the table *t* to attract the armature *s*.

Current for energising the electromagnet *w* was controlled by two contacts, one being a platinum tip on the pendulum, the other taking the form of a stationary light spring mounted on an ivory block secured to the standard *a*.

The inventor contended that, by using lengths of wire up to about 2,000 ft. on the magnets *w*, ensured greater reliability when using small currents; also, it effected an economy in batteries.

Assuming that the gravity arm *g* is retained by the end of *c* in the elevated position, as shown in Fig. 1, then on the pendulum *p* swinging to the left, the screw *m* will engage *e*, and displacing it also to the left causes *c* to become raised, at the same time releasing *g*.

In falling, the part *h* of the arm *g* impacts with the screw *j*, and so an impulse is given to the pallet *i*, which in turn is transmitted to the pendulum. This member now commences its return swing impulsed by the gravity arm *g*, but towards the end of its swing the contacts engage. Current from a battery now energises the electromagnet *w*, which puts down the armature *s*. Since *s* is attached to the lever *n*, its outer end will be raised, and through engagement with *f*, the gravity arm moving to the left will lift the detent *c*, and *g* will be reset ready for the next impulse.

The pendulum commencing its return swing to the left will again release the gravity arm *g* and the cycle of operations will be repeated. The novel features of the scheme are that impulses

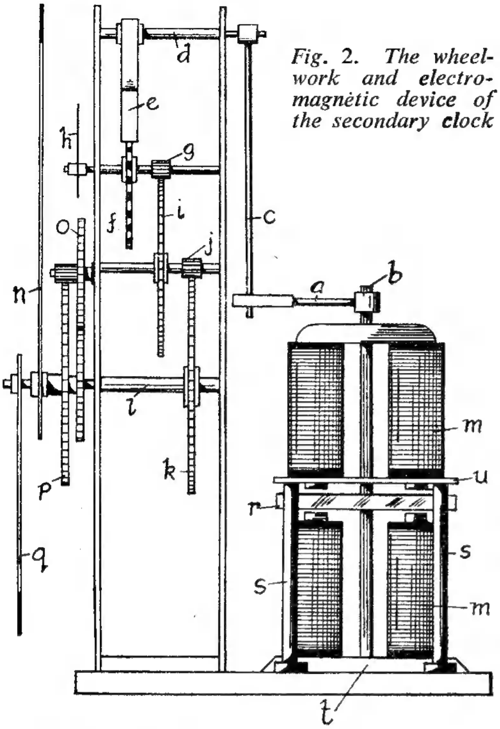


Fig. 2. The wheel-work and electro-magnetic device of the secondary clock

given to the pendulum are constant, and the arc of vibration remains constant.

The condition of the battery could not affect the time keeping, provided there was enough electrical energy to reset the gravity arm. It might be pointed out that, in the electric pendulums devised by Bain and others, the arc of vibration was directly affected by the changing condition of the batteries. Consequently, there was a slight error in the time rate of the clocks.

The Secondary Clock

Referring to Fig. 2, it will be seen that the clock consisted of two parts.

On the left is a train of wheel-work common to a good weight-driven clock. On the right we have

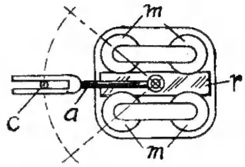


Fig. 3. Plan view of electromagnets

an electromagnetic contrivance for driving the wheelwork.

Concerning the wheelwork, *l* is the arbor on which is mounted the "great" wheel *k*, which meshes with a pinion *j* on an arbor carrying the wheel *i*, the latter meshes with *g* secured to the seconds' arbor on which is mounted the escapement wheel *f*.

The seconds' arbor, extending through the front clock plate, is provided with a hand *h*. Special shaped pallets *e* attached to an arbor *d* have a semi-rotary movement received from a crutch-rod *c*. The latter is oscillated by an arm *a* attached to the upper end of the spindle *b* of the electromagnetic driving gear. This consists of four pairs of double-coil electromagnets *m*, two pairs being superimposed so that all poles are facing and a gap exists between them,

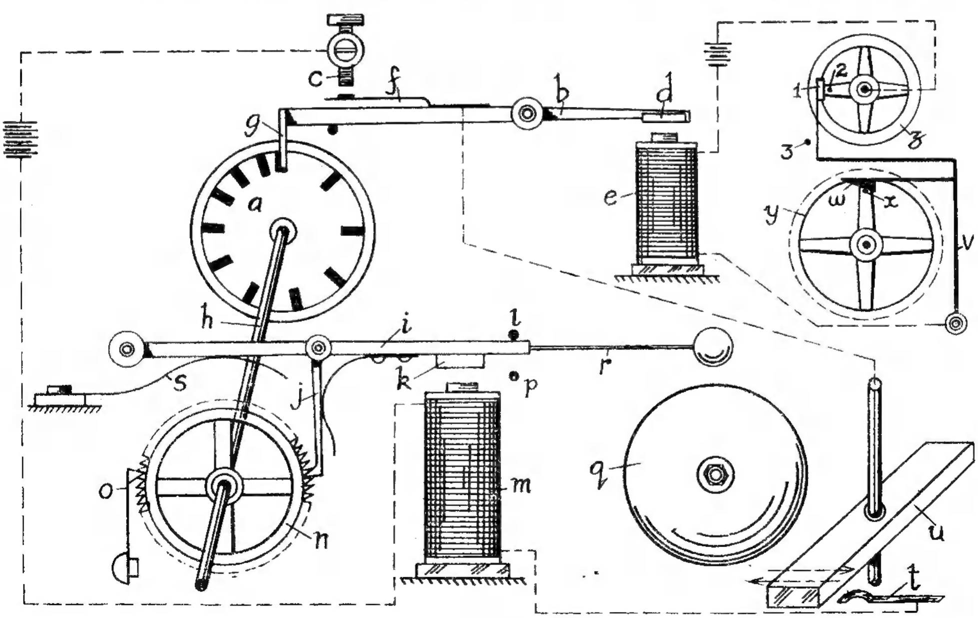


Fig. 4. The striking gear

in which the bar-magnet *r* is free to oscillate.

The bottom electromagnets are supported on a framework *t*, whilst the top electromagnets are secured to a plate *u* carried on columns *s*.

A plan of the electromagnets is shown in Fig. 3. As the electromagnets alternately attract and repel, the bar magnet *r* secured to the spindle *b* will make one oscillation per second, consequently, the escapement wheel *f* will be progressively propelled by the rocking pallets *e*. This movement is then transmitted down through the wheel-work and dial wheels *o* and *p* to the minute and hour hands *n* and *q* respectively.

How the currents are transmitted and controlled to the electromagnets *m* will be rendered clearer by reference to Figs. 1 and 5. The two platinum-tipped contact springs, 2 and 3, are mounted on an ivory base, one spring on each side of the pendulum. The springs engage the pendulum platinum-tipped portion towards the end of each swing.

The batteries were used and wired to the contact springs in such a manner that when the springs contacted with the pendulum, the current became reversed through the clock electromagnets.

Recourse to the use of two batteries and the two spring contacts caused the reversal of current, thereby dispensing with the need of a current reverser.

A large slave clock was mounted above the principal entrance to the 1851 Exhibition, the dial being semi-circular to harmonise with the design of the Crystal Palace. The concluding article of the recent excellent series by "The Domine," included an illustration of the large dial equipped with double hands. (See THE MODEL ENGINEER for October 18th, 1951.)

The Striking Gear

It is only to be expected that a striking gear should be included in the system and to replace the usual gear train, Shepherd devised the arrangement sketched in Fig. 4.

Mounted on an arbor *h*, is a locking plate *a* and a ratchet wheel *n* with 78 teeth. The ratchet wheel being propelled tooth by tooth by a pawl *j* pivoted to an arm *i*. The arm *i* also carries a soft-iron armature *k* and a wire stalk *r* terminating in the hammer; movement of *i* is controlled by two stops *l* and *p*.

To return *i* against the stop *l*, a spring *s* is used. Back turning of the wheel *n* is prevented by a back stop *o*.

The locking plate *a* is normally locked by the end *g* of a pivoted lever *b*, the free end of *b* has an iron armature *d* which is attracted by an electromagnet *e*; *b* also has a contact *f* for establishing contact with the pillar and screw *c*.

To solve the problem of releasing the gear at the precise moment, an insulated arm *v* was introduced having at its lower end a small wedge-shaped piece *w* raised each hour by a pin *x* projecting from the hour wheel *y*.

The upper end of *v* is provided with a small platinum pad 1 for engagement with the pin 2 carried by the escapement wheel *z*; the arm *v* normally reposes against its stop 3.

As an interval of time must elapse between each blow of the hammer on the gong, the oscillating bar-magnet *u* was found suitable for the purpose.

The magnet *u* completed the circuit with a fixed spring *t*; since the magnet takes two seconds to swing to and fro, the interval elapsing between each blow will be obviously two seconds.

On the stroke of the hour, the pin *x* raised *w*, which in turn displaced *v*, causing the platinum pad 1 to approach a pin 2 projecting from the wheel *z*.

On engagement of 1 and 2, current from a battery excited the electromagnet *e*; the armature, on being pulled down withdraws *g* from the notch of the wheel *a*, simultaneously closing the contacts *f* and *c*.

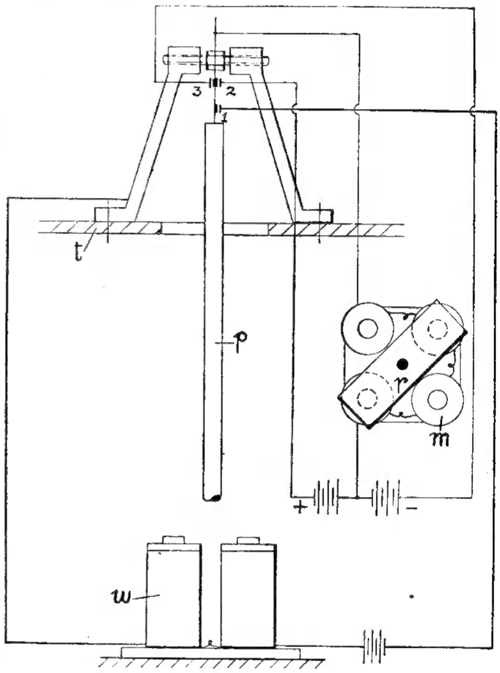


Fig. 5. The wiring system of the master and secondary clocks

Current from another battery circulates the electromagnet *m*, and, pulling down the arm *i*, the pawl *j* advances the wheel *n* one tooth; the hammer at the end of *r* will also strike the gong *q*. When the bar-magnet *u* swings clear of *t*, the arm *i* is released and returns against the stop *l*; at the same time *j* engages another tooth of the wheel *n*.

And so the action continues until *g* at the extremity of *b* drops into one of the notches of the locking plate *a*; opening of the contacts *c* and *f* stops the striking mechanism.

Application of Electricity to Horology

Shepherd proposed to use his master pendulum transmitter to ensure uniform time in the various departments of large establishments, observatories and railway stations.

(*Continued on page* 107)

"Britannia" in $3\frac{1}{2}$-in. Gauge

by "L.B.S.C."

Brake Gear

HAVING now made all the "going" part of the engine, except a couple of details to be described before the boiler, we might as well make some provision for stopping it; and as it is easier to fit the brake gear to the chassis before putting on the boiler, here are details of same. Whilst the brake gear is of the same general design and arrangement as in full size, it differs in detail, both for ease of making and fitting, and to suit the small size of the locomotive. On the big engines, the brake cylinder is rigidly attached to the frame, and the piston is connected to the actuating arm on the brake shaft by a connecting-rod working inside a hollow piston-rod. This would be far too flimsy for $3\frac{1}{2}$-in. gauge, so I am specifying a direct connection between piston-rod and arm, and mounting the cylinder on trunnions to allow for the end of the arm moving in an arc. Again, on the full-size job, there is no compensating gear and no adjustment for the brake pull rods. The compensating gear is also not necessary on the small edition, but provision is made for adjustment of the rods, so that the blocks can be made to contact the wheel tyres all together. Twin pull-rods are used between the leading and middle beams, instead of a single rod as in full size; these are necessary to clear the pump feed pipe, the pump being "a little bit of something that the big one hasn't got." The pull-rod forks on big sister have extended jaws, which pass right across the beams and connect to the next pull-rod in advance; the arrangement shown is simpler and better in small size. So much for generalities, and now to construction. The brake gear is, of course, no use for service stops, as a load of passengers on the cars would only cause the engine to slide or skid; therefore, fitting it is optional, but it adds a finishing touch to the locomotive, and has the saving grace of actually working.

Gear Frame—Casting

The brake cylinder and brake shaft are mounted on a separate frame, making the assembly self-contained, and this bag of tricks is erected just ahead of the trailing coupled axle, as shown in the accompanying illustrations. The frame may be cast, or built up in alternative ways; the casting makes for the easiest job, and it won't give our approved advertisers the awful "pain in the neck" that they collected over the motion brackets! All it consists of is a frame stay with a couple of projections standing out at right angles, to accommodate the brake cylinder and shaft; and it needs very little in the way of machining. The ends should be squared off to fit nicely between the frames, same as the pump stay and the other stays. The inside of the bracket part should be smoothed with a file, so that the inside measurement is $\frac{13}{16}$ in. Two No. 30 holes are drilled for the trunnion pins of the brake cylinder, as shown, but it wouldn't be of any use to drill $\frac{3}{16}$ in. plain holes for the shaft bearings, as you couldn't get the shaft in place. Drill a couple of No. 30 holes first, at the location shown, and test for alignment with a bit of $\frac{1}{8}$ in. round silver-steel; when O.K., open up to 11/32 in., and tap $\frac{3}{8}$ in. × 40. Make a couple of screwed bushes, as shown, from $\frac{7}{16}$ in. hexagon brass rod; these are reamed $\frac{3}{16}$ in., and the screwed ends faced off, so that when in place, the ends are $\frac{11}{16}$ in. apart as shown. Don't fit to frame yet; this is done when the blobs and gadgets are fitted to it, and the method is the same as described below for the built-up contraption.

Gear Frame—Built-up Version

First, you need a frame stay 1 in. deep. This can be made exactly as described for the other frame stays; a piece of flat plate $2\frac{5}{8}$ in. × 1 in. × $\frac{1}{8}$ in. thick, with a bit of angle brass of $\frac{3}{8}$ in. × $\frac{1}{8}$ in. section riveted at each side, or a similar but longer piece with the ends bent over, as shown in the plan. A cast frame-stay may also be used, but whatever the pattern, it should be a nice fit between the frames. The two brackets for carrying the brake cylinder and shaft, are cut from 16-gauge steel, to the given dimensions. Here again, you can choose between a bent-over flange, pieces of angle riveted on, or separate castings. One may be riveted to the stay, but one must be left off until the assembly stage, or the brake shaft cannot be put into place. Note the slight offset at bottom; this is to allow the stay to be fitted just in front of the block at the bottom of the horncheeks, as shown.

Brake Cylinder

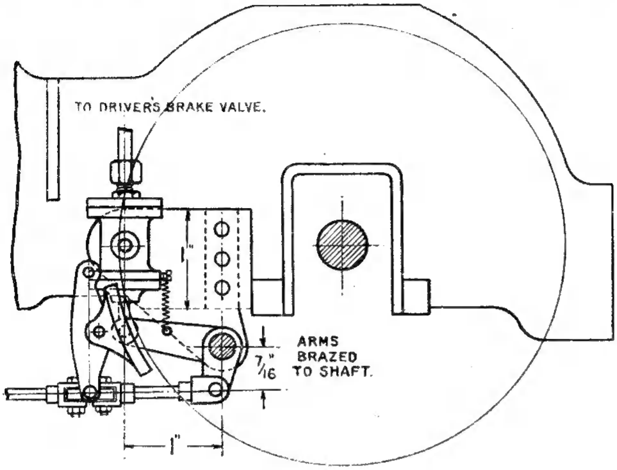
After the engine cylinders, the brake cylinder is just a piece of cake. A casting can be used, but actually there is no need to bother about one, as the cylinder body can be turned from $\frac{3}{4}$ in. rod; bronze or gunmetal for preference, but brass will do at a pinch, as the wear is negligible. Chuck in three-jaw, face the end, centre, and drill a $\frac{1}{8}$ in. pilot hole to a depth of about $\frac{7}{8}$ in., opening out with 23/64-in. drill. Starting a full 3/32 in. from the end, using a roundnose tool, turn down the outside to $\frac{1}{2}$ in. diameter for a length of $\frac{9}{16}$ in. bare, then part off at a full $\frac{3}{4}$ in. from the end. Rechuck, parted end outwards, holding by the flanges, so that only about 1/32 in projects beyond chuck jaws; skim the end to get a true face, and put a $\frac{3}{8}$ in parallel reamer through the bore.

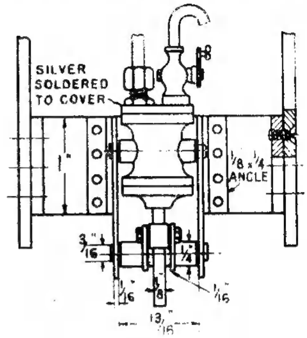
A casting can be bored and reamed in the chuck, one end being faced at the same time; the other end can be faced and the outside of the flanges turned to size with the casting mounted

on a stub mandrel held in the chuck.

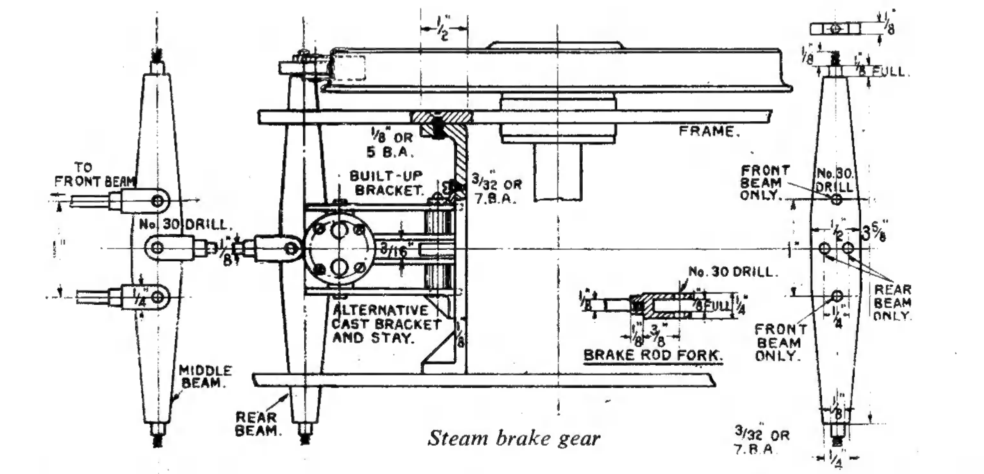
Both top and bottom covers can be turned from rod $\frac{3}{4}$ in. diameter ; for the top one, face the end, turn the register to a full 1/64 in. depth, a nice fit in the bore, and part off at a bare $\frac{1}{8}$ in. from the end. For the bottom one, turn the register, then centre, and drill No. 30 for about $\frac{5}{16}$ in. depth. Part off at a full $\frac{1}{4}$ in. from the end, reverse in chuck and turn the little bevelled boss as shown in the illustrations. The top cover has two

The piston and rod are made and fitted in the same way as their bigger relations in the engine cylinders, so I need not dilate at length on that job. The lower end of the piston-rod is reduced and screwed 3/32 in. or 7 B.A., to take the big-end (some big end, at that !) same being merely a $\frac{3}{16}$ in. slice of $\frac{1}{4}$ in. round rod with a No. 30 hole through it, and a tapped hole in the thickness, to suit the screwed end of the piston-rod. As there is so little hold for the threads ,





End view of assembly



Steam brake gear

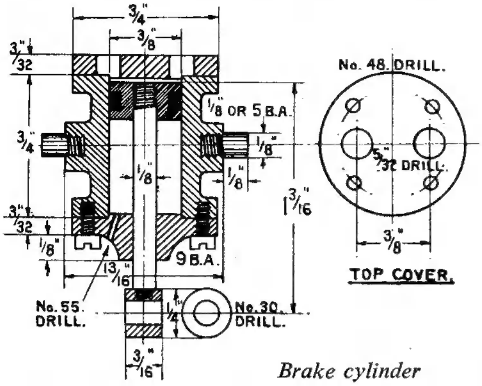
5/32-in. holes drilled in it at $\frac{3}{8}$ in. centres as shown ; and the bottom one, a No. 55 vent hole, to admit air under the piston. Both covers are attached by 9 B.A. screws.

A cast cylinder will have the trunnion bosses cast on it, but one turned from rod will need two, made from $\frac{1}{4}$ in. round rod, silver-soldered on. These are drilled No. 40, tapped $\frac{1}{8}$ in. or 5 B.A., and are furnished with $\frac{1}{8}$ in. silver-steel trunnion pins screwed to suit. If the combined cast stay and bracket is used, make a screwdriver slot in each trunnion pin, as the cylinder will have to be put in place, and the trunnion pins screwed in through the holes in the bracket.

it would be advisable to apply a spot of silver-solder, to make certain it doesn't come adrift. The piston is packed with graphited yarn, just a few strands wound into the groove will do nicely.

Before assembling the cylinder " for keeps," the top cover needs a weeny cock body, and a 7/32 in. × 40 union screw silver-soldered into it. There is hardly enough hold for screw threads. The union screw is made in the same way as the one under the lubricator, but use $\frac{1}{4}$ in. hexagon rod, and leave a tiny bit of hexagon, about $\frac{1}{16}$ in., between the screw and spigot. The cock body is the same as will be described, all being well,

for the cylinder drain cocks in the near future. It is for blowing the condensate water out of the cylinder when first operating the brakes after getting up steam on the engine.



Brake cylinder

Brake Shaft Assembly

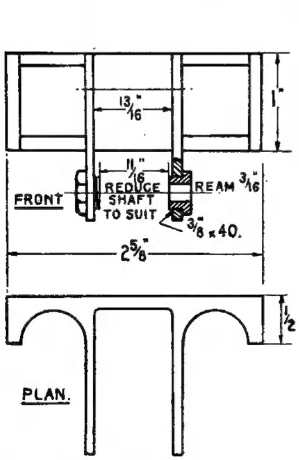
The brake shaft itself is a piece of $\frac{1}{4}$ in. round steel (mild or silver) $1\frac{1}{16}$ in. long, the ends being reduced to $\frac{3}{16}$ in. diameter, so that for use with a built-up bracket, the distance between shoulders is $\frac{15}{16}$ in., and for a combined cast bracket, $\frac{11}{16}$ in. The latter allows for the projection of the screwed bushes; see cross section. The shorter arm is cut from $\frac{1}{8}$-in. steel and squeezed on to the middle of the shaft; the two longer ones are cut from $\frac{1}{16}$-in. steel, and squeezed on, one at each side, the distance between them being $\frac{3}{16}$ in. full. The holes in the smaller ends are drilled No. 30. The two longer arms are adjusted to be parallel with each other, and at right angles to the shorter one; the joints can then be brazed, as previously described for small parts, using brass wire or Sifbronze rod for the job. Quench in water only, and clean up.

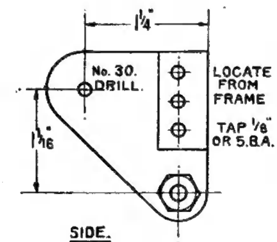
How to Erect

First assemble up the brake cylinder and shaft on the bracket. With the cast combined bracket and stay, just put the cylinder in place and screw in the trunnion pins through the holes in the bracket. Take out the bushes at the bottom, put the shaft in place—easily done through the big holes—and screw the bushes in, so that the reduced ends of the shaft enter the holes in the bushes. The shaft should be quite free, but not "sloppy." If the built-up bracket arrangement is used, attach one bracket plate to the stay, put the brake cylinder and shaft against it, with one trunnion on cylinder and one end of shaft in their respective holes; put on the other plate, and attach to stay by screws, as shown in the plan view. Alternatively, the plates can be riveted to the stay after putting the shaft in place, the cylinder being erected by removing the trunnions, as in the case of the casting. Then put the big-end between the two long arms and secure by a little bolt like that at the top of the combination lever.

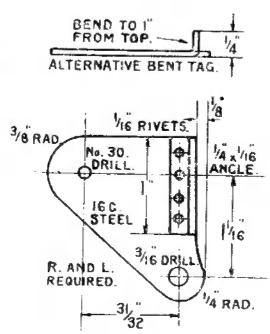
To release the brakes, put a screw edgewise in the cylinder cover and flange, as shown in the elevation; 9 B.A. is plenty big enough. Attach one end of a tension spring made from 22-gauge steel wire to the screw, the other end being put through a $\frac{1}{16}$ in. hole drilled in one of the long arms on the brake shaft. An alternative method which I have used with success, is to put a bronze spring on the piston-rod inside the cylinder, which pushes the piston direct to the top of the cylinder as soon as steam is shut off and the driver's brake valve turned to release position.

On each side of the frame, at $1\frac{1}{4}$ in. ahead of the trailing coupled axle centre (that is, approximately $\frac{5}{8}$ in. from the hornblock), drill three No. 30 holes in a vertical line and countersink them. The bottom one is $\frac{3}{16}$ in. above bottom of frame, and the others at $\frac{5}{16}$ in. centres, as shown in the elevation drawing; the drilling is easily done between the wheel spokes. Now put the cylinder-and-shaft assembly in place between the frames, the stay resting against the hornblock feet, and the bottom of stay level with bottom of frames. Poke the No. 30 drill through the holes in frame, making countersinks on the stay flanges; follow with No. 40 drill through the countersinks, tap $\frac{1}{8}$ in. or 5 B.A., and put countersunk screws in. Terribly difficult job, this locomotive building—did I hear somebody chuckling?





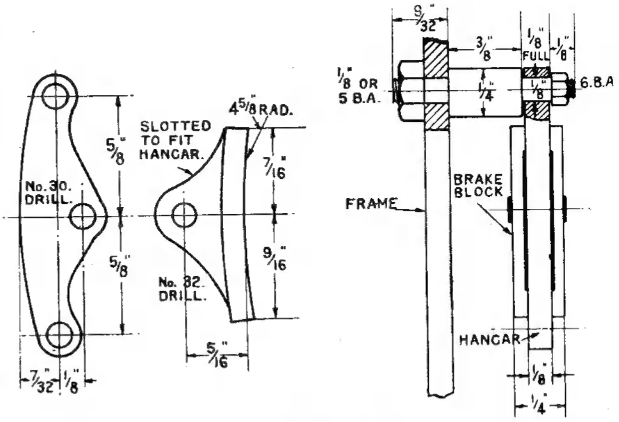
Above: Alternative cast combined stay and cylinder bracket



Right: Built-up bracket

Brake Rigging

The rest of the job is just as simple as the brake gear on little *Tich*. The hanger pins are turned from $\frac{1}{4}$-in. round steel, to the dimensions shown in the end view of the block-and-hanger assembly; the $\frac{1}{8}$ in. screwed ends are poked through the holes in frames,



Brake blocks and hangers

and nutted inside. The hangers are filed up from $\frac{1}{2}$ in. × $\frac{1}{8}$ in. steel, to shape and dimensions shown, and drilled No. 30. The brake blocks may be filed or milled from $\frac{1}{2}$-in. × $\frac{1}{4}$-in. mild-steel, as per the *Tich* instructions, or they can be castings. I shouldn't be surprised if our enterprising advertisers cast the blocks in soft-iron, ready slotted, same as full size; this saves work, as all that is needed is to drill the pin-holes, and pin the blocks to the hangers by $\frac{1}{8}$ in. silver-steel pins. The blocks should be free enough on the hangers, to adjust themselves to the wheels, but not free enough to lop over and rub on the wheel treads when the brakes are released. The hangers are kept on the pins by 6 B.A. nuts, as shown.

The brake beams are made from $\frac{1}{2}$-in. × $\frac{1}{8}$-in. steel, and the ends are first turned and screwed to given dimensions, with the pieces of rod chucked truly in the four-jaw; the beams can then be filed to the given outline, and drilled as indicated, the front one having two holes on the centre-line 1 in. apart, the middle one ditto, with a third hole between, and the back one having two holes in the middle, at $\frac{1}{4}$-in. centres. The beams are placed between the bottomsof the hangers, which go over the plain spigots, and are secured by 3/32 in. or 7-B.A. nuts; the joints must be quite free.

The brake beams are connected to each other, and to the drop or actuating arm on the brake shaft, by pull-rods made from $\frac{1}{8}$-in. round steel, furnished with forks or clevises made in the same way as those in the valve gear. Eight of these will be needed; two on the leading beam, three on the middle beam, two on the rear beam, and one at the bottom of the drop arm. They are all made from $\frac{1}{4}$-in. square steel rod, to the dimensions given in the illustration. I usually do the whole lot at one fell swoop, cutting off four pieces of $\frac{1}{4}$-in. rod about 2 in. long, and slotting both ends of each on my milling machine; it can be done in the lathe, as per *Tich* notes, if no miller is available. I then saw or part off the slotted ends, chuck each truly in the four-jaw (by slacking and retightening the same two jaws, it is easy to have them all true) turn the bosses, and drill and tap the ends. The jaws are cross-drilled with a bit of $\frac{1}{8}$ in. packing between; and finally, the ends rounded off.

The lengths of the pull-rods are easily obtained from the actual job. Attach the forks to the beams; turn the chassis upside down on the bench, press the brake blocks against the wheels, line up the forks, and apply your "stick of inches" to the bosses, measuring from one to the other, and allowing $\frac{1}{8}$ in. extra at each end, to enter the bosses. Cut the rods to lengths indicated, screw the ends, disconnect forks, screw the pull rods into the bosses, replace forks and secure them to the beams by $\frac{1}{8}$ in. bolts; couple up a tyre pump to the union on the brake cylinder, and pressure on the handle should "plonk 'em on," as the enginemen would say. There should be enough tension on the spring to ensure easy release.

The Shepherd Electric Clock System

(*Continued from page* 103)

It was also suggested that his world-famous 24-hour "electric-magnetic" clock set up at Greenwich Observatory might be used to control a large central clock in London which in turn would transmit time signals to various railway stations.

The clock at the Greenwich Observatory was arranged to transmit electrical impulses for releasing a large time-ball for ships in the Thames to correct their chronometers. About that period, electrically controlled time-balls were often erected on the roofs of telegraph offices.

It may be of interest to state that Shepherd, in 1851, read a paper before the Royal Society of Arts describing his electric clock system.

One writer in 1859 made the following comments:—

"Electro-magnetic clocks have not yet come into general use, partly owing to imperfections in the battery connections, which occasionally put a stop to their movements, but principally on account of the high prices charged by patentees.

"As no trains of wheels are requisite in an electro-magnetic clock, it might be manufactured very cheaply; and when the price is reduced to its proper standard, and the trifling practical defects are remedied, these clocks may possibly supersede others."

A MODEL MECHANICAL EXCAVATOR

by J. E. Day

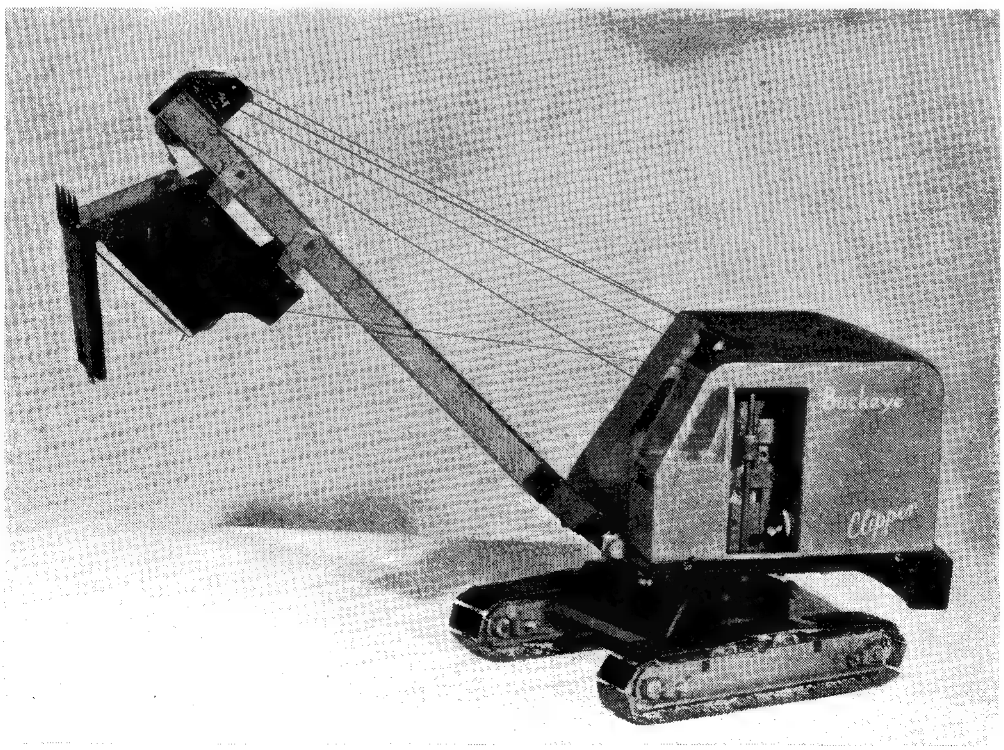
I HAVE always been interested in all quarry machinery and cranes—so much so, that I built a small working quarry complete when still at school. Then I turned my interests to more serious work and decided to attempt construction of a working model—the " Universal Excavator," with what tools and material I had at my disposal.

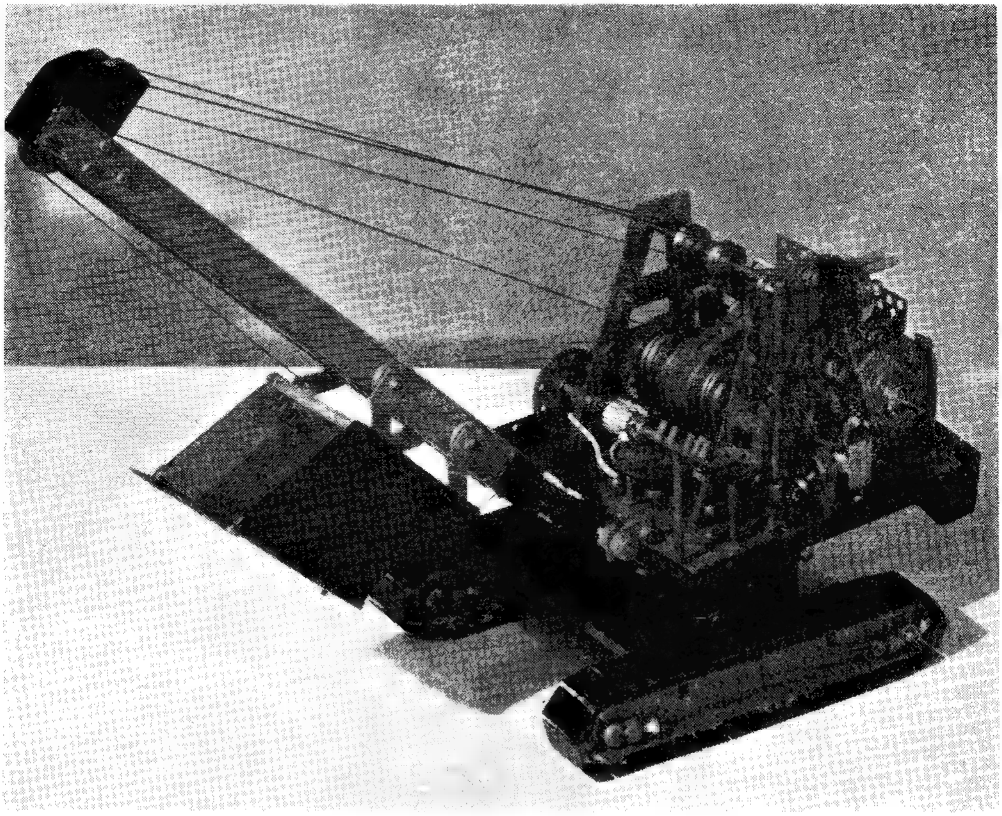
I decided that it should be designed and constructed so that it could be dismantled easily if found necessary for repairs, etc. The excavator I have made is a replica of an American type of machine like the one being used in a sand pit close by to where I live. I took measurements of this machine, and the first component was the carriage of the machine, which consisted of the framework to carry the driving sprockets and idler wheels for the trucks, and also the dog clutches and brakes for the independent slewing of the tracks; the tracks consist of two lengths of sprocket chain 14 in. long with 38 brass plates $1\frac{1}{8}$ in. $\times$ $\frac{3}{8}$ in. soldered to each length of chain.

Having built the carriage, I went on to build the base. This is a brass box which is fitted to the carriage with four screws. Fitted to the base is the gear ring on which the rest of the machine revolves. In the centre of the gear ring there is fitted an insulated brass slip-ring to convey the tower to the driving motor of the machine and also on the base is fitted the king-pin, which holds the rest of the machine on to the gear-ring.

Then, having completed two units of the machine, I started on the floor, which is a brass plate $5\frac{1}{2}$ in. $\times$ 6 in. with four small ball-races fitted on angle brackets and another ball-race fitted in the floor, $1\frac{1}{2}$ in. from front end; this ball-race slides over the king-pin in the base and when tightened down with a nut brings the four small ball-races down on to the gear ring. There is a lead counter-weight bolted to the floor and also a set of dummy controls, and the operator's seat.

I now come to the next unit which is the *A* frame. This is bolted with four bolts to the floor; fitted in the *A* frame are two large rope barrels for digging equipment and a small worm-driven rope barrel for operating the boom. Behind these rope barrels is fitted the electric motor for driving the machine, which is a 12 V d.c. totally enclosed motor. Fitted to the motor is a small worm-wheel which meshes with a worm





pinion on the main drive shaft. From this shaft are three countershafts, one operating the boom-raising barrel, one operating the two large rope barrels by means of jockey pinions connecting the barrel gears to the shaft gears. The third countershaft operates the travelling and cab slewing movements; this shaft revolves in the centre of the king-pin. Directly behind this shaft there is a short shaft running through the floor with a small pinion on the end, which meshes into the gear ring on the base for the slewing movement. All the control levers of this machine have been brought to the back of the machine to make operating easier. I now have my four units. They can be made into one unit or back into four units in a matter of minutes.

My next job was to build a cab for this machine, and I did this entirely from tin. It is an all-soldered construction with two sliding doors in the back and one at the operator's side. I have also fitted three windows in the front of the cab.

All excavators with three-roped barrels are called "universal" excavators because they can operate all the principal digging attachments, of which there are six. These are, the trencher, skimmer, face shovel, drag-line, grab and pile-driver. I am now able to carry out all these operations with my model excavator.

To make this digging equipment, I started by constructing a 2 ft. 6 in. lattice boom, for use as drag-line, grab, pile-driver and crane. This boom is made from ½-in. aluminium angle, with brass end and bearing to fit on to excavator. I then made a drag-line bucket. This bucket hangs on a pair of chains on a rope going over the top of the boom down into one of the large rope barrels. At the front end of the bucket there is a second pair of chains fastened to a rope which passes through a fairlead at the bottom of the boom on to the second large rope barrel. The fairlead is a small fitting with two horizontal pulleys and two vertical pulleys to guide the rope on to the barrel.

I then went on to make the grab. This is a device with two hinged portions forming a bucket; the closing action forms a digging action. The grab has two ropes to operate it—one to hold it up, the other to open and close it. I have also a small counter-weight running in a tube in the centre of the boom with a rope going on to the grab, to stop the two operating cables from twisting; this same boom also operates the pile-driver and crane.

I then constructed a short brass boom for the trencher shovel and skimmer equipment. The skimmer bucket is square on four rollers running on the boom, and when digging, it is pulled through the earth to the end of the boom. The

(*Continued on page* 115)

Locomotive Valve Timing

by C. M. Keiller, M.I.Mech.E.

THE designing of a locomotive valve-gear is looked on by some people as a very difficult and perhaps rather mystical subject, while others think there is nothing to it. Actually it is a very normal engineering job that requires a bit of paper work and some engineering knowledge. With a steam engine it is almost impossible to produce something that will not work somehow, but between just working and the best results there is a very large gap, and to design a first-class valve-gear does need really expert knowledge, both as to the mechanical arrangement and to the choosing of the valve setting. Part of this knowledge is the ability to set out quickly the results that would be obtained from any particular arrangement, in other words, if a certain lap and lead and cut-off be required, it can be immediately found out what travel is needed and what would be the timing of the exhaust events, etc. This does not need any great skill or knowledge; it is simply a matter of knowing how to draw a particular type of diagram. While this article does not attempt to deal with the design of valve-gear or even as to what settings are most desirable, it does show how to draw and use these diagrams, and for anyone who is new to this method, this ability will prove a very useful and fascinating acquisition. However, before doing any more about the diagrams, it is necessary to consider some other matters so that it may be understood what is being done and also what is possible.

There are, of course, several different types of valve-gears in general use and if each of them imparted a different character of movement to the valve, investigation of this movement and the consequent timing of the valve would be a very complicated affair. Fortunately, however, this is not so. All mechanisms using simple levers to convert rotary motion to reciprocating motion, even if two or more are combined together, impart to the valve what is known as simple harmonic motion, so that when investigating the behaviour of a valve under any given set of conditions, we can assume it is being driven by a simple eccentric of the requisite travel and advance; this is called the equivalent eccentric. When a valve or such like is being driven by a rotating crank, its speed varies in a regular manner from zero at each end of the stroke to a maximum in the middle, but no clear idea of the character of the motion can be gained unless it can be represented in a drawing. If the position of the valve for, say, each 15 deg. of crank movement, be plotted on a time base, that is at regular intervals along a straight line, a curve of a very definite shape will be formed. It is, in fact, the curve that would be traced if a pencil were attached to the valve spindle and a piece of paper were passed under it at a constant speed as the crank rotated. Fig. 1 shows how this curve is drawn and what it looks like.

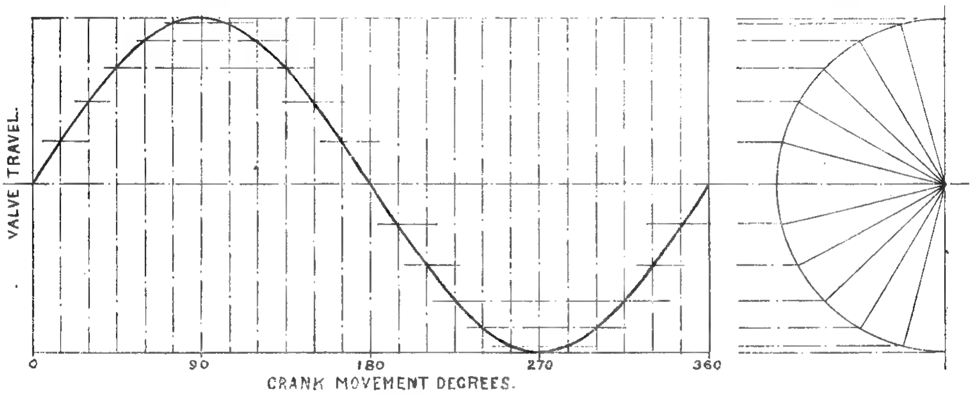


Fig. 1. Curve of simple harmonic motion

So much for the single eccentric. With Walschaerts gear there are two distinct movements, one derived from an eccentric or return crank at 90 deg. to the main crankpin and which is obviously the same type of mechanism as the simple eccentric except that the movement transmitted to the valve can be varied in amount and reversed in direction by the link, the other, which is derived from the crosshead, is just a reduced copy of the piston movement. Both these movements are combined at the valve spindle crosshead. These two movements mixed by the combination lever, give a movement which is exactly the same in type as that of either of the constituent movements, but different in amplitude and phase (Fig. 2 illustrates this), curve *A* representing the lap and lead movement from the crosshead and is of $3\frac{1}{2}$ in. travel as being typical of a modern locomotive. Incidentally, the diagrams throughout this article are dimen-

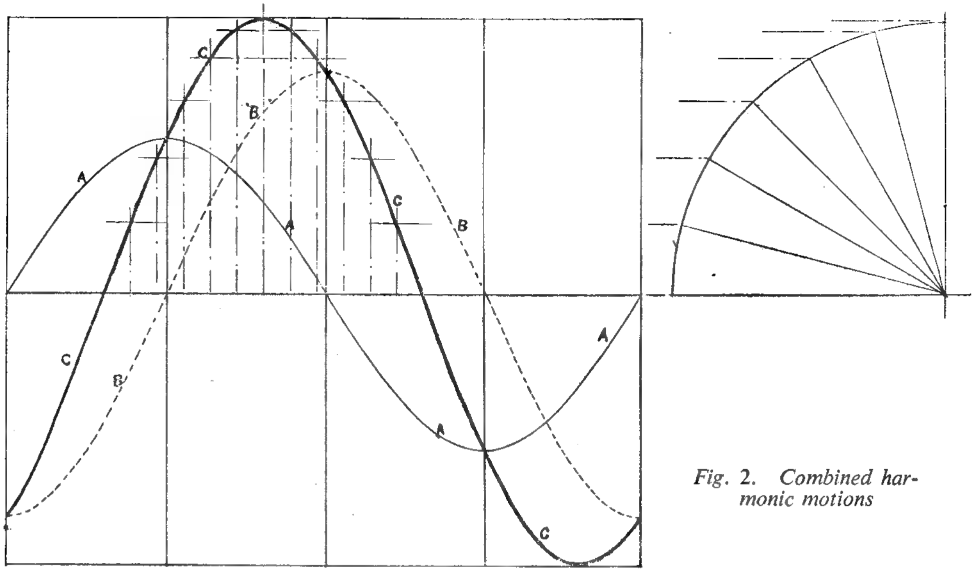


Fig. 2. Combined harmonic motions

sioned as for the full-size engine, this being rather easier to handle than model sizes, but the principle is exactly the same. Curve *B* represents the movement from the link and is of 5 in. travel, which is approximately the full gear amount. The construction of neither of these curves is shown, it is as in Fig. 1. Curve *C* shows the actual travel of the valve and is obtained by adding the ordinates of curves *A* and *B* together. It shows a combined travel of $6\frac{1}{8}$ in. with ■ phase between the two ; as the gear is notched up, *B* gets less and less in amplitude until it disappears, *C* also gets less and less in amplitude but also its phase position moves towards *A* until it disappears into *A* and only that curve is left ; this condition represents mid-gear. Curve *C* was actually drawn by adding *A* and *B*, but on the diagram it is traced back to a circle of the appropriate diameter, and it will be seen that it is also ■ true simple harmonic curve.

The other valve-gears in normal use are amenable to exactly the same treatment. With Joy gear the main movement is derived from the vertical movement of the main connecting-rod and is variable and reversible by the curved slides ; the lap and lead movement is obtained from the fore and aft motion of the main connecting-rod. So both these motions are derived from the rotation of the crank in the first place, and are combined as in Walschaerts gear. The link gears are a bit different ; here the complete full gear movement is obtained from one eccentric, but the link enables any position between the two full gears to be used, and these can be represented quite accurately by an equivalent eccentric. Of course, none of these gears gives perfect distribution, that is pure simple harmonic motion. Even the single eccentric has an error due to eccentric-rod angularity. All the more complicated gears have various errors due to the imperfect suspension of links and such like and rod angularity, but well designed Stephenson and Walschaerts gears have no serious errors. Joy gear is reasonable, but there is quite a serious error due to the curvature of the slides which is always noticeable in the exhaust beat when the slides are tilted backwards.

All the foregoing may seem rather dry and academic, but it had to be established that a valve driven by any normal valve-gear always moved as if driven by ■

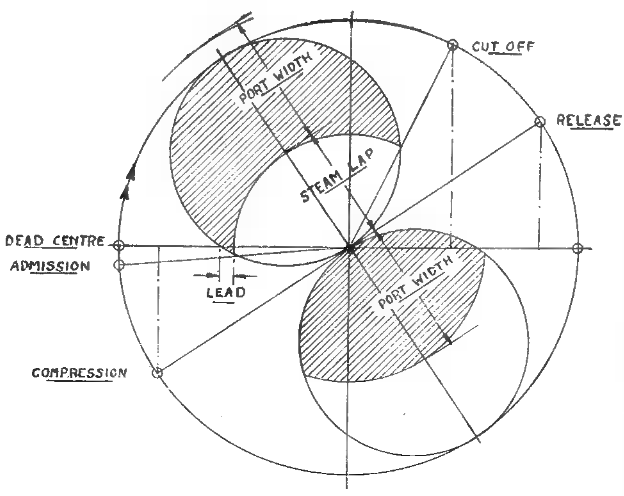


Fig. 3. The Zeuner valve diagram

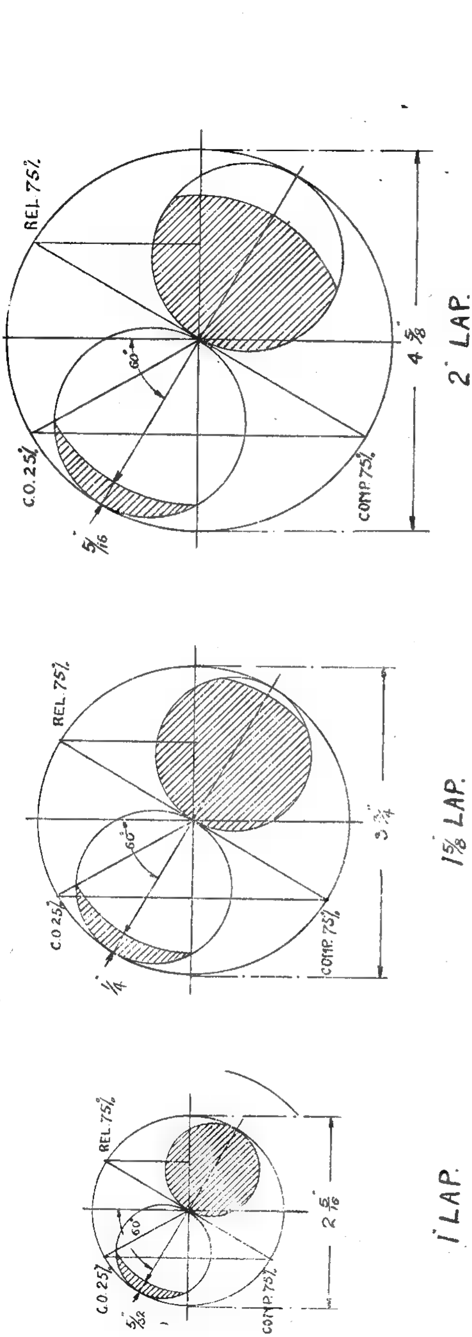


Fig. 4. Effect of increasing lap w th constant cut off

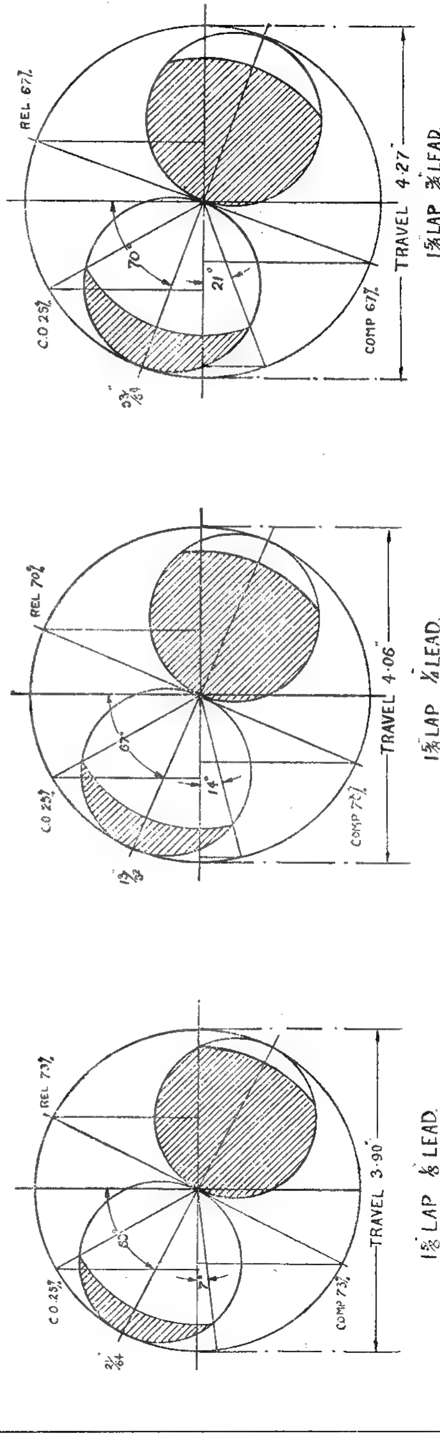


Fig. 5. Effect of increasing lead with constant lap and cut off

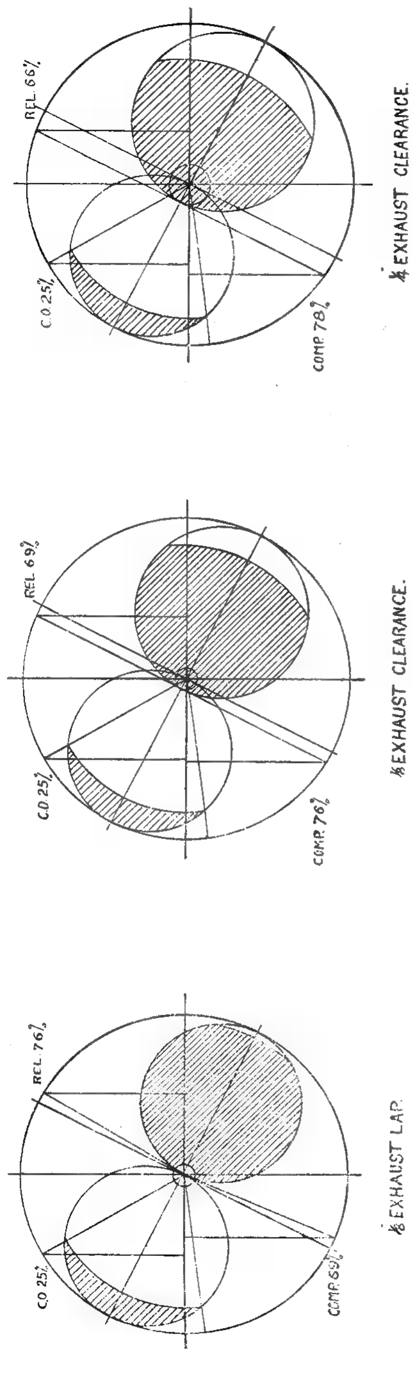


Fig. 6. Application of exhaust lap and clearance

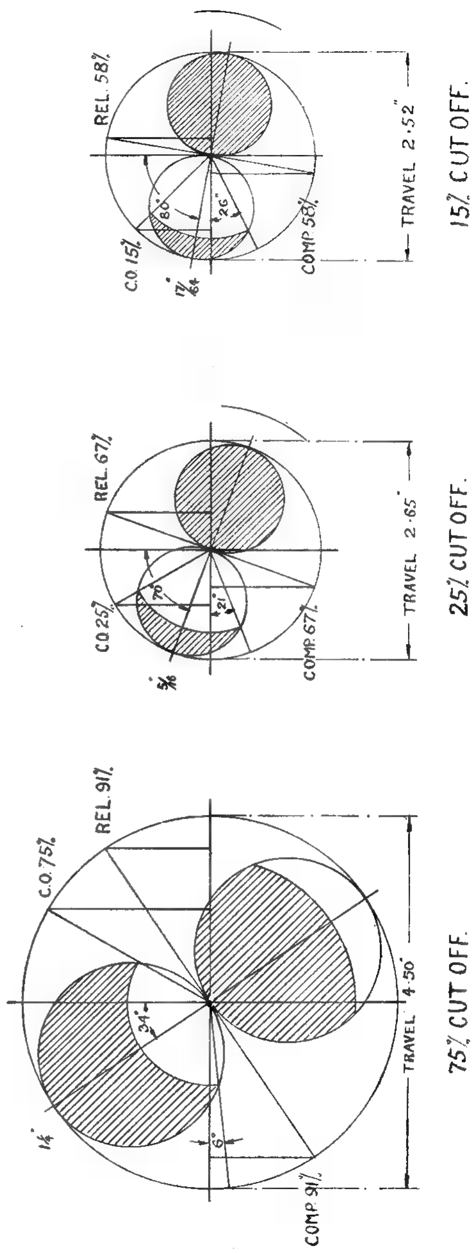


Fig. 7. Variation of cut off with 1 in. lap and ¼ in. lead

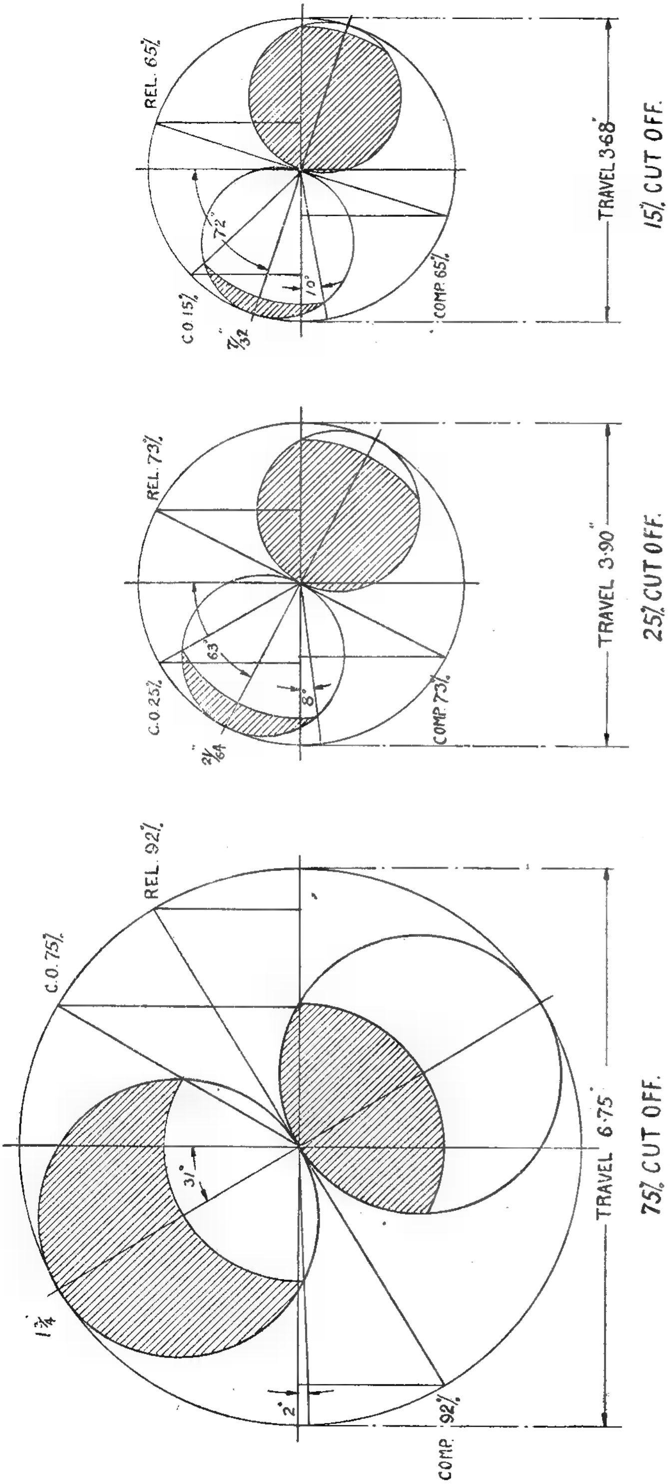


Fig. 8. Variation of cut off with $1\frac{1}{8}$ in. lap and $\frac{1}{8}$ in. lead

simple eccentric, and this being so its performance under any given set of conditions can be ascertained by drawing a very simple diagram. Thus, if lap, lead and travel be known, the cut-off, release and compression points and port openings could at once be seen or vice versa. There are several types of such diagrams in general use and the one chosen for use here is known as the Zeuner diagram, shown in Fig. 3, the large circle represents the crankpin path on a reduced scale. The crankpin is assumed to be moving in a clockwise direction; starting from the left-hand dead centre it indicates the points of cut-off, release, etc., as it travels round the circle, either in degrees from the dead centre or as is more usual as percentages of distance along the horizontal stroke. The large circle also represents the valve travel in actual size, the laps are shown full-size as radii from the centre, the two small circles are used to give the timings and the port openings, the top one represents the steam edge and is drawn so that the required or actual lead is shown, and the bottom one, which represents the exhaust edge has necessarily to be exactly opposite. The diameter onwhich these circles are drawn indicates the advance of the equivalent eccentric, an eccentric at 90 deg. to the crank is taken as having a nil advance. The shaded areas denote the actual port opening. It will be seen that such a diagram can be very useful in finding out in what way alterations, say, of the lead or lap, affect the compression and release points, and also what can and cannot be done, as all the events are interdependent and everything cannot be exactly as might be desired. These diagrams can be used only with sliding

valves directly operated by the gear. Cams or poppet valves cannot be dealt with.

Having now established that the movements of any sliding valve driven by a normal gear can be represented by a simple equivalent eccentric, and that with a simple diagram this movement can be shown as it affects the timing and port openings, this knowledge can be used to investigate the effect of varying the laps, leads and also how the timings and openings are varied as the gear is notched up and the cut-off shortened. In any investigation of this sort it is necessary to alter only one variable at a time, otherwise the cause and effect may be obscured. As steam lap is one of the most important dimensions of the slide-valve, this will be dealt with first. Fig. 4 shows three diagrams each with 25 per cent. cut-off, each with nil lead, line and line exhaust edge, and $1\frac{3}{4}$ in. ports. The steam laps are different, as are also the travels, as this latter has to be adjusted to the laps to keep the cut-offs constant at 25 per cent. It will be seen that as the steam lap is increased the steam port opening increases *pro rata*. It will also be seen that the timings are quite unaffected, the exhaust port opening also increases but not *pro rata*. As with the two larger laps it is more than fully opened for part of the time.

The next most vital thing to consider is the lead. Fig. 5 again shows three diagrams, each with $1\frac{5}{8}$ in. steam lap, line and line exhaust and 25 per cent. cut-off, but with different leads. Now, if these diagrams be compared with the centre one of Fig. 4, it will be seen at once that lead increases the steam port opening very appreciably for a quite small increase in the valve travel, but it will also be seen that increase in the lead has a very marked effect on the timing of all the events, these being advanced very materially.

So far, in all the cases dealt with, the exhaust edge of the valve has been what is called line and line, that is with no lap or clearance, but these can both be applied and modify the exhaust timings. It will, of course, be appreciated that exhaust timing can hardly be varied directly by altering the angle of advance of the eccentric, as this is primarily fixed by the requirements of the steam edge; but, as this article is attempting to show, suitable manipulation of the lap and lead can vary the exhaust events to a certain extent even for the same cut-off and port opening. Usually, exhaust timings do not become troublesome except at short cut-offs and then both release and compression tend to become too early. Unfortunately, nothing that can be done in the way of lap or clearance will cause both of these events to become later at the same time. If lap be added the release will become later, but the compression will be earlier, if clearance be given, the opposite will take place. Both these effects are shown in Fig. 6, where three diagrams are shown, each with 25 per cent. cut-off, $1\frac{5}{8}$ in. lap and $\frac{1}{8}$ in. lead. One shows exhaust lap and the other two exhaust clearance. It will be seen that exhaust clearance has also the effect of increasing the exhaust port opening, and for this reason has been used quite a lot to give additional freedom to the exhaust steam, but its use, of course, entails an extra early release timing at short cut-offs.

To finish up, two sets of diagrams (Figs. 7 and 8) are given, showing the effects of shortening the cut-off, one set with a typical short-travel valve, 1 in. lap, $\frac{1}{4}$ in. lead, and the other with a long travel valve, $1\frac{5}{8}$ in. lap, $\frac{1}{8}$ in. lead, actually the Churchward setting. At 75 per cent. cut-off, there is very little difference in the timings, but the port openings are much larger with the long travel valve, the exhaust port being fully open, $1\frac{3}{4}$ in. on the dead centre, in all positions, whereas with the short travel it only opens $1\frac{1}{4}$ in. on dead centre and on short cut-offs never fully opens at all. As regards port openings to steam, the matter is quite different. At 25 per cent. both gears open about the same amount, but all the timings are earlier with the short travel. At 15 per cent. cut-off the port opening to steam is actually greater with the short travel, but the timing of admission, release and compression is excessively early.

It will be seen that nearly all the valve events influence each other in some way. If certain data is given, the rest follows inevitably. It is not possible to arbitrarily fix all the timings and openings, but with the knowledge gained from the use of these diagrams it is possible to so arrange the primary events that the secondary ones come as near as possible to what is desired.

A MODEL MECHANICAL EXCAVATOR

(*Continued from page* 109)

bucket is emptied by releasing the hinged bottom with a spring-loaded catch.

I then constructed another small brass bucket for use as shovel and trencher. I also had to make a short brass channel dipper arm which has the bucket on one end and is pivoted about half way up the boom for the shovel; the bucket is then drawn up to the end of the boom. For the trencher, the dipper arm is pivoted at the top of the boom, the bucket is reversed and drawn towards the cab when digging.

I now have an excavator that has done many hours successful working with all its equipment.

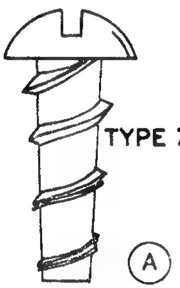
I have done all my model building in my back garden shed, but still hope to spend many more hours building some more models connected with quarry machinery.

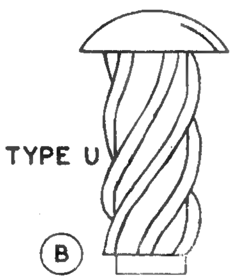
Joining Plastics

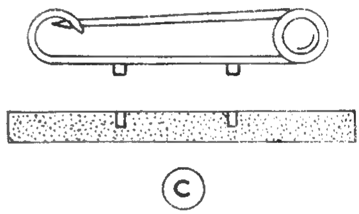
by P. W. Blandford

WHEN making joints between them, the solid plastics can be treated in many ways the same as wood or metal.

It is possible to tap plastics so that joints can be made with B.A. or similar screws, but it is unwise to attempt threading with a die. It is better to use self-tapping screws. A machine-thread screw will sometimes strip the thread in plastic, but Parker Kalon steel self-tapping screws driven into holes of the appropriate size will make a very firm fixture. Normally the type driven with a screwdriver is used (see Sketch *A*), but drive screws (Sketch *B*) have their uses. These latter are made in sizes from the very fine ones used to secure a clip to a fountain pen up to sizes much bigger than the model engineer is likely to use. The small parallel portion at the end is the same diameter as the tapping size drill. Squeezing in is preferable to hammering.







Riveting is best avoided unless the heads can be spun. Gentle burring into a countersink with a light hammer is possible for some forms of construction.

Metal fittings can be attached to plastic by lugs pressed into undersized holes. Commercially-produced brooches, etc. are usually assembled in this way (see Sketch *C*). A gentle squeeze in the corner of the vice will do the job. If the hole is only slightly undersize, there is no need to soften the plastic, but if you are afraid of cracking, soften it in boiling water and use hand pressure only to assemble the job.

There is no universal glue for plastics. Most plastics have their particular adhesives, some respond to solvents and a few just cannot be stuck.

"Perspex," either clear or coloured, is probably most commonly used. There are a number of ways of joining it to itself, but not so many for joining it to other plastics or other materials. The manufacturers make two cements for joints in Perspex—"Tensol" No. 2 is the stronger, but it is not advised for large areas. It is wisest to avoid large jointing areas, by cutting away backgrounds, but if this cannot be avoided then "Tensol" No. 6 cement should be used.

Tensol cements are quick-setting. An ample quantity should be applied to both surfaces and all air bubbles squeezed out. Taping around the joint is advised, as it is difficult to avoid an excess of cement, and this would mar the surrounding surface.

Joints may be made by softening the parts with

(*Continued on page 120*)

NETTLEFOLD PARKER KALON SCREWS—DRILL SIZES

Type Z

Screw No.	Drill No. "Perspex"	Drill No. Other Plastics
2	49	47
4	40	39
6	32	30
7	30	29
8	28	25
10	20	16
12	14	8

Type U

Screw No.	Drill No.
00	55
0	51
2	44
4	37
6	31
7	29
8	27
10	20
12	11
14	2

A Small Semi-Portable Steam Engine

by C. Blazdell

Fig. 1. Engine as originally built

THE engine illustrated in the accompanying photographs and drawings was made as a present for a small grandson, but grandpa himself getting interested in its construction, rather more work was put into it than was essential for a toy.

As it was built up from scrap and odd parts, no attempt could be made to produce a scale model, but the general effect is that of a small semi-portable engine, as used in considerable numbers for small power purposes prior to the advent of the electric motor and i.c. engine.

The type makes ■ model convenient for handling, as the engine, boiler and firing arrangements make up into ■ self-contained unit. The imitation locomotive-type boiler is of the Smithie's pattern and follows the usual run of such units. It contains three $\frac{1}{4}$-in. tubes silver-soldered into ■ $1\frac{3}{4}$ in. diameter barrel 7 in. long. The outer casing is $2\frac{3}{4}$ in. diameter and this and the firebox is lined with $\frac{1}{8}$ in. thick asbestos millboard.

The engine is an orthodox slide-valve type, the cylinder, which is the only casting, once belonging to a launch engine. For this reason the bore and stroke are equal—$\frac{11}{16}$ in., but ■ longer stroke would be more in keeping with a portable engine.

The crankshaft was built up from $\frac{3}{16}$ in. diameter silver-steel rod and carries eccentric sheaves of the normal type for both valve-gear and feed pump. As originally built, the feed pump was attached to the side of the firebox,

which was not unusual with this type of engine in full scale practice (see Fig. 1).

In the model, however, the firebox wrapper-plate is in direct contact with the heat—despite the asbestos lining—unlike the true locomotive-type boiler, which, of course, has a water jacketed firebox. As a result, the pump in the model became very hot and this was thought to account for its unsatisfactory working. The pump was accordingly moved to the position shown in Figs. 2 and 3, vertically under the crankshaft where the temperature was lower, and heat insulating washers placed between the boiler barrel and pump.

The wooden "bedplate" is hollow in the centre to contain the spirit tank, and a brass plate $\frac{1}{8}$ in. thick on top of the wood serves to mount the boiler on. A small water tank is bolted under the pump, the whole forming a self-contained unit. The working pressure is 30 p.s.i. and the boiler was hydraulically tested to three times this pressure by its own feed pump.

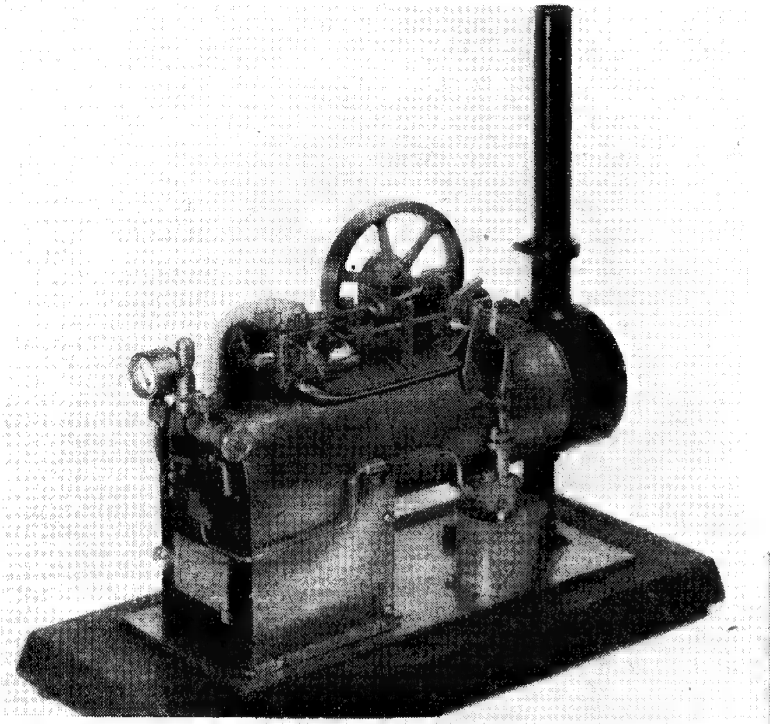


Fig. 2. View from firebox end

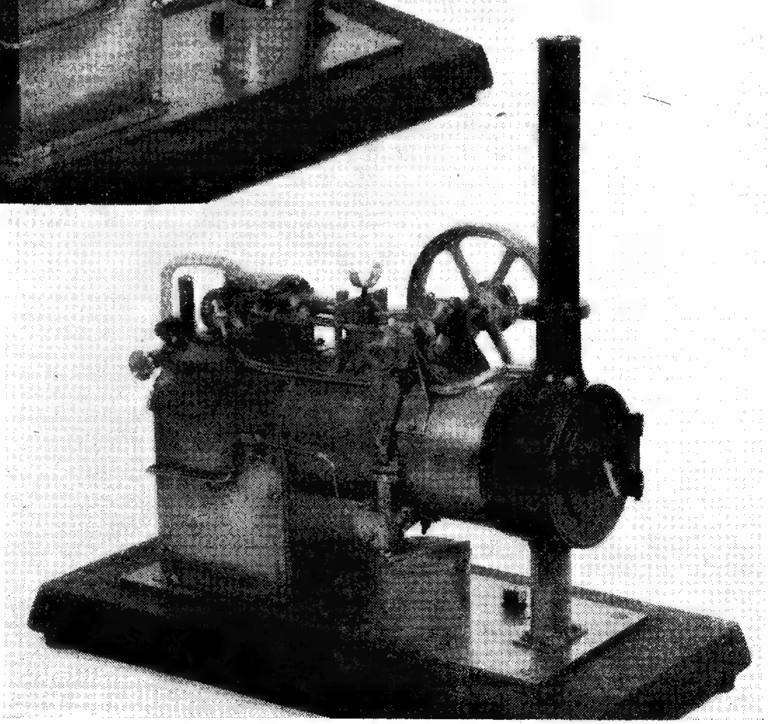


Fig. 3. View from smokebox end

Fig. 5a. General arrangement, side elevation

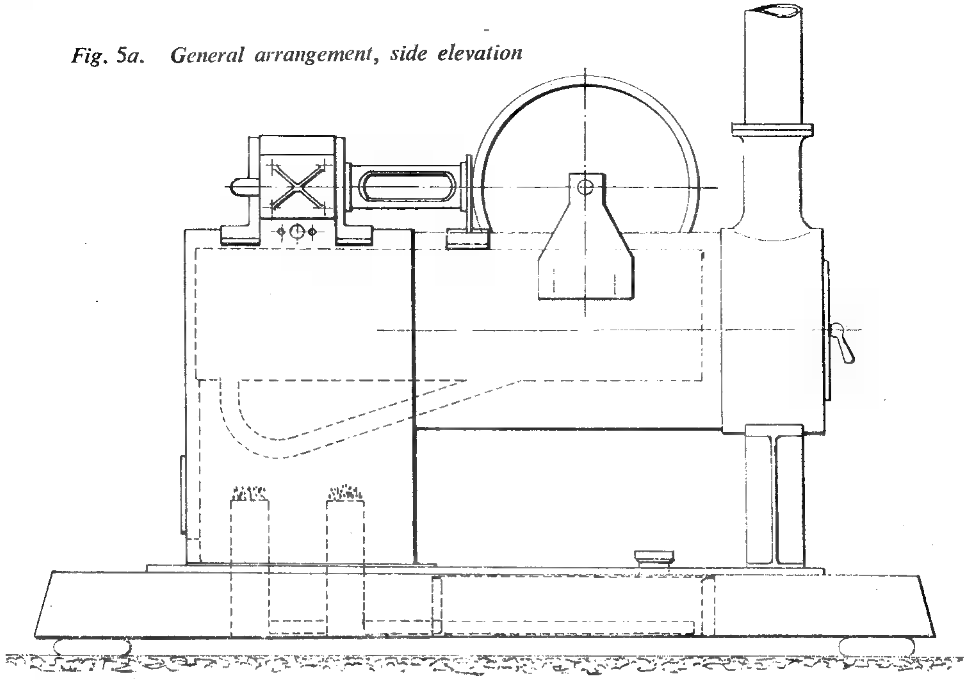
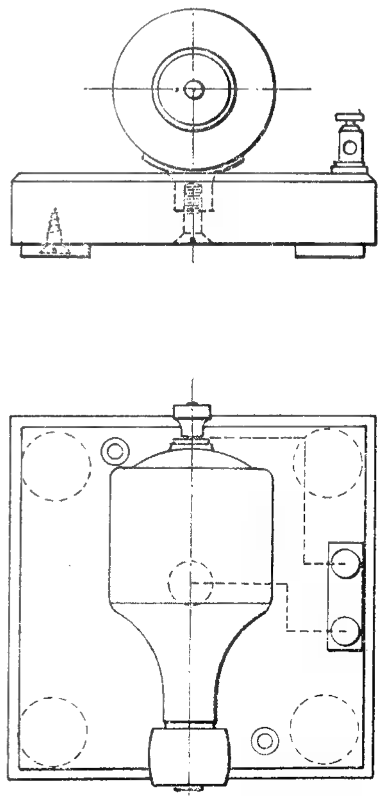
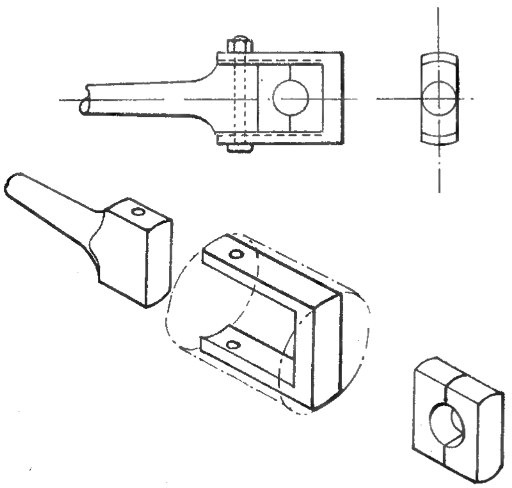


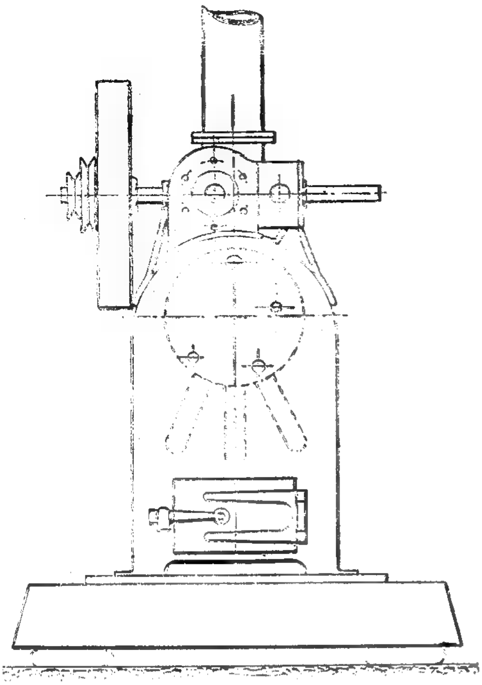
Fig. 4 shows the method adopted for making the connecting-rod big-end. This is not, of course, in line with real practice, but was adopted because all parts can be turned or bored, and fitting is, therefore, a simple matter. The finished appearance is very similar to the real job. The strap was made from a short length of round bar drilled out, making a sort of thimble. The butt-end of the connecting-rod and the brasses were turned to fit the thimble. Opposite sides of the thimble were then filed away, leaving



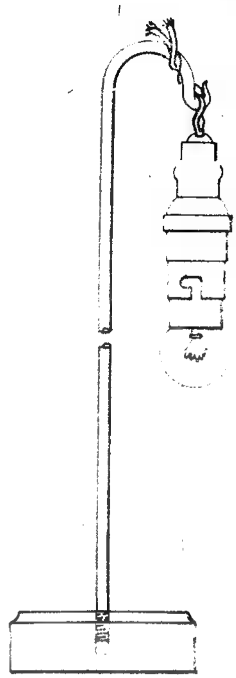


Above : Fig 4. Construction of connecting-rod big end.

Right : Fig. 7, Dynamo



Left : Fig. 5b. General arrangement. Elevation of firebox end.



Right : Fig. 6. Standard Lamp

the strap as shown, which only needed a bolt representing the orthodox gib and cotter to complete.

Later, when it became necessary to provide something for the youthful owner to drive with his engine, an " electric generator " was installed. This consists of an old and partly worn-out cycle dynamo. The original knurled pulley running against the cycle tyre was removed and a new convex-faced pulley made and fitted. The driving belt was made from ⅜ in. wide insulating tape with a sewn joint, and runs on the rim of the engine flywheel (Fig. 7).

A lamp standard was made from odds and ends. The base consists of a stub end off a length of shafting tapped to take a 10-gauge upright from which the lamp socket is suspended at the top by the flexible leads which coil up the post. A tubular post with the flex inside would make a neater job. When working with its full boiler pressure of 30 p.s.i., the engine just manages to keep a 6 V 3 W motor-car side lamp bulb running at its proper brilliancy.

Considerable amusement and instruction have been derived by the young owner from this equipment and further models of a mechanical nature, such as pumps, etc., for driving from the engine are contemplated.

Joining Plastics

(*Continued from page* 116)

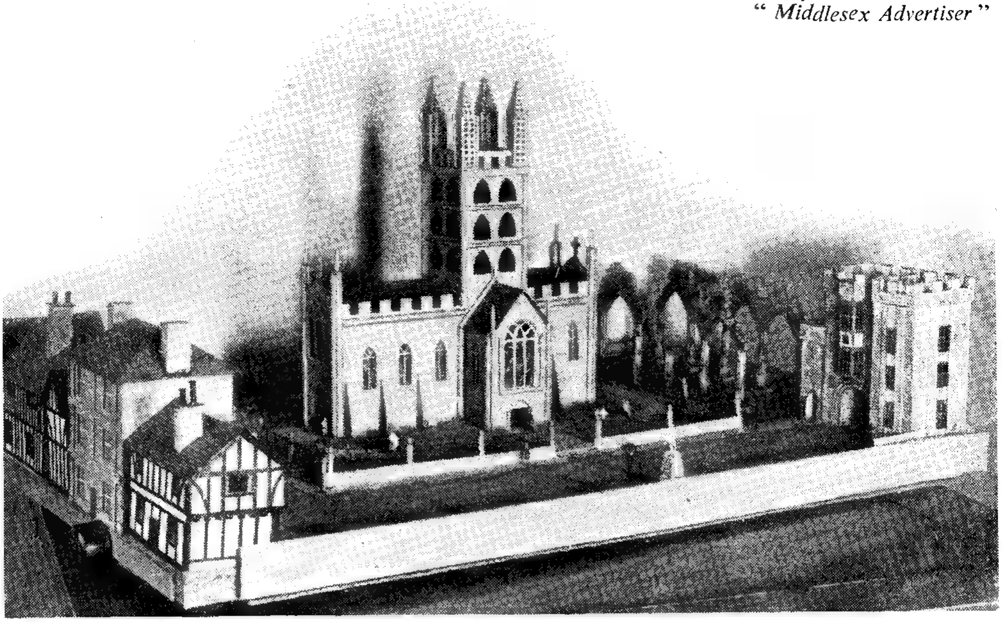
a solvent and pressing them together to form a weld, but the solvents are not common and may be dangerous in unskilled hands, so that the use of the normal cements is advised.

For joints in Catalin the makers supply Catacol. This is also used as a waterproof wood glue. It is supplied as a syrup, with a liquid accelerator. The two are mixed just before use. Catacol has a comparatively short shelf life.

Casein may be joined to itself, wood or other plastic by any good hide woodworking glue. Where maximum strength is not essential, a tube glue may ge used for most plastics. Casein cement, which is used as a water-resistant wood glue, can be used on casein plastic, but it does not seem to be any stronger than ordinary hide glue.

The nearest to a universal plastic glue is resorcinol. This is another synthetic resin wood glue, but with a much longer shelf life than Catacol. It consists of a dark red syrup and a white powder accelerator. It will join Casein, Catalin and Perspex to themselves or to either of the others. Unfortunately its dark red colour is sometimes objectionable, making it unsuitable for clear Perspex, but for opaque plastics a thin red joint line does not matter.

Photo by
" Middlesex Advertiser "



A Model of a Cathedral Close

by D. C. Oehl

BEFORE I commence this description, I would like to point out that this " Cathedral Close " is a section of the fictitious city of " Barryport " in the country of " Mardon," situated on a model railway. " Barryport " itself is a flourishing sea port, which has an old and interesting history, and it is with one of the more ancient sections of the city in mind that I have tried to reproduce this model.

On the site of the present " Cathedral of St. Peter " originally stood an Abbey which dated back to roughly the 11th century, the ruins of which can be observed railed round and in excellent state of repair for such an old historic building.

To the north side of the Abbey ruins one can observe the Abbey gateway, which is a later addition and only rebuilt after the building of the present cathedral, which was finished some time during the 14th century. The cathedral itself being commenced after the Norman conquest, the main archways are of Norman design. The two most renowned features of the " Cathedral of St. Peter," are the square and ornate tower, and the big stained glass west window (made up, incidentally, from an old broken up lantern slide with coloured cellophane paper stuck on the back). During the hours of darkness, this looks exceedingly majestic and beautiful, being lighted in the interior with three lights arranged throughout the building, as also are all the buildings throughout the entire model, and to complete the "after dark " picture, five street lamps are arranged along " Abbey Road," and lit with small pea lamps, the power being supplied from the ordinary house mains through three small transformers, and hidden inside various buildings.

The gardens and lawns surrounding the cathedral are a sight to be proud of, and are the pride and joy of the bishop, who can be observed leaving the pilgrims door at the north side. At this time of the year, the flower beds are a maze of colour from assorted coloured tulips (made from a quantity of Lil pins pushed into balsa wood and surrounded with real dried and powdered earth sprinkled on glue. The lawns, after several experiments, were made from odd scraps of curtain velour, painted with a flat green paint. The pathways consist of ordinary sand sprinkled through a flour sieve over a coating of Gloy). The pigeons, are quite tame, and enjoy being fed by visitors, the children on the lawn being no exception. The buildings surrounding the cathedral consist, mainly, of examples from the Tudor period, and starting from the south side we have an excellently preserved Tudor period hall which in the model now serves " Barryport " as the Town Hall, and has just received a visit from the postman who is about to mount his bicycle (soldered up from fuse wire). Next door to this is a small house of Tudor style which has been converted into an antique shop, and manages to keep its stock going from antiques collected from the surrounding districts. Some of these antiques may be observed in the small shop window, at the

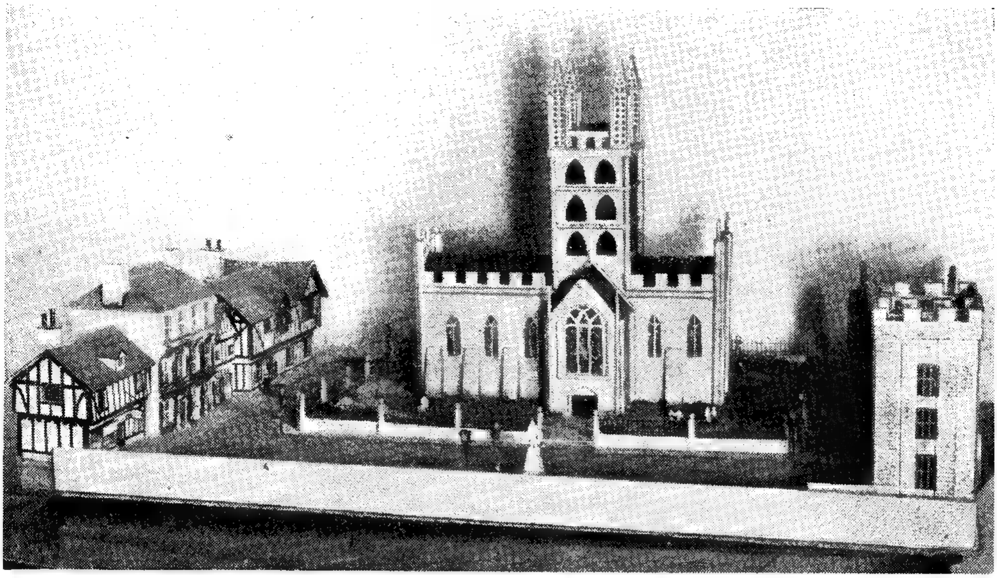


Photo by] [" *Middlesex Advertiser* "

rear of which is a fine gilt-framed oil painting of one of the founders of the town hall next door. The collection of books in the opposite window contains several which recount the long and varied history of " Barryport."

Moving further along " Abbey Road," we come to a more recent building, which is built on the site of some early Tudor houses, which, unfortunately, could no longer be preserved by the " clerk of the works." This large house of three stories is of the Georgian period, and boasts some very fine window boxes, the lower portion of the house being entirely covered with a rich coating of ivy. (The " window box flowers," being coloured cake decoration, sprinkled on to glue, and the " ivy " a fine powder again sprinkled on glue, and painted with a dark flat green paint.) This building, standing as it does between buildings of Tudor design, emphasises the contrast in type of the two periods.

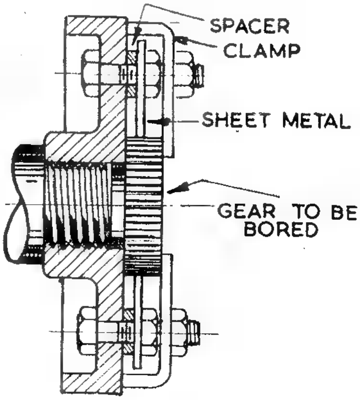
The Tudor building on the north side of the Georgian house is now a tea room, which bears the name of the " Cathedral Cafe," and is well and truly patronised by visitors to the cathedral, much to the delight of " Mrs. Hemsworth," who can be observed looking out of an upstairs window (looking for customers, maybe).

Moving along Abbey Road towards the Abbey gateway we pass a fine statue of one of the ancient kings of " Mardon," who gazes majestically down at the quiet and peaceful gardens in front of the cathedral.

On leaving " Abbey Road," we can either go under the Abbey gateway, or along the narrow " Abbots Alley " (no cycling by request) back into the hustle and bustle of the main road.

Enlarging Bores of Stock Gears

The drawing herewith illustrates a reliable and accurate method for enlarging the bores of stock gears, requiring no indicator. Cut a circle of sheet metal, which must be 1 in. less in diameter than the faceplate. Use snips to cut circle. Bolt the circle to the plate, using spacers. Bore a hole in the sheet metal a close fit for the gear, without any play. Clamp the gear in position with extra nuts on the same bolts, as shown in sketch. Care should be taken in order not to loosen or move sheet metal circle.—A. RICHARDS.



Shaping in the Lathe

by "Duplex"

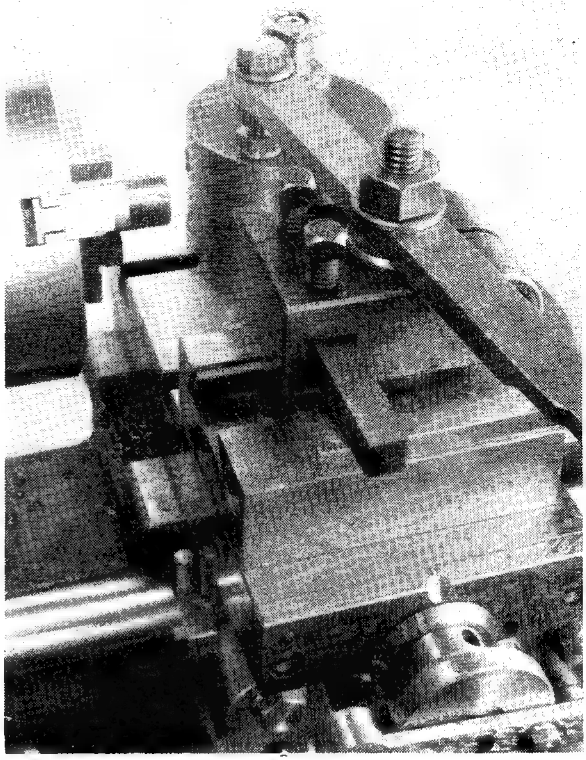


Fig. 1. The shaping attachment in place on the Drummond lathe

ALTHOUGH the lathe can hardly be regarded as an efficient substitute for the shaping machine, there are, nevertheless, times when it will be found more convenient for shaping small work.

For example, ■ work-piece, after being machined and while still held in the chuck, can have a keyway cut exactly radially, and at an angle in keeping with ■ previously machined taper, whereas the necessary set-up in the shaping machine might take rather a long time and would certainly need great care to obtain an accurate result.

Descriptions have appeared in this journal of operations such as shaping or planing the bed of a small lathe when mounted in ■ larger lathe. But this entails rocking the lathe saddle to and fro by hand, and in this way, for carrying out a single operation, the bed may be subjected to more wear than it would receive in months or years of normal use. For this reason, this method of working is, perhaps, best avoided, for wear of the lathe bed is both difficult and expensive to correct. Instead, except in an emergency, it is usually preferable to confine shaping operations in the lathe to the use of the topslide travel; for, apart from turning short tapers, this slide is mostly used for setting the cut, and wear is, here, not a serious matter, as it can be readily corrected.

The Shaping Attachment

The design of the shaping attachment will necessarily depend on the constructional details of the lathe employed, and the equipment that has been used for many years with ■ Drummond $3\frac{1}{2}$-in. lathe will be described in detail, before dealing with attachments suitable for some other types of lathes.

The top slide is, first, made free to slide by removing the feedscrew together with its keep-plate, and the slide gib is then adjusted to give free but shakeless movement. As readers will

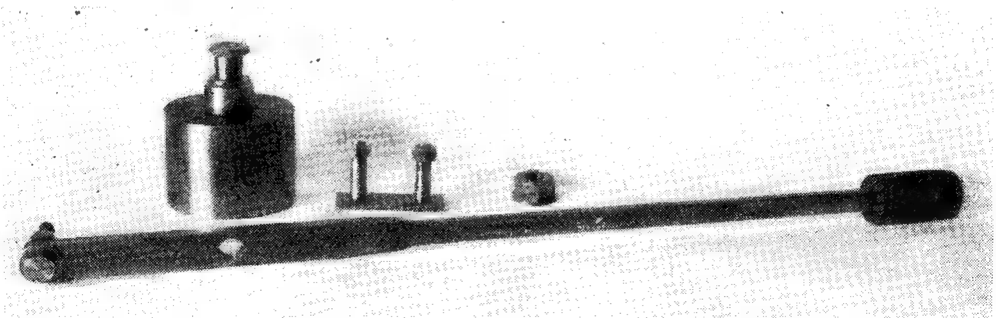
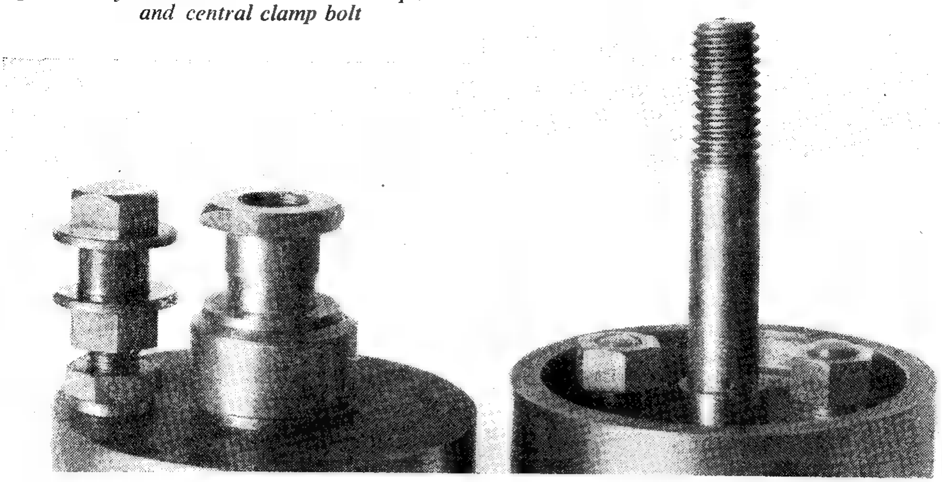


Fig. 2. The components of the attachment

Fig. 3. The fulcrum block with the lever pivot and central clamp bolt



know, the cylindrical toolpost of the Drummond lathe is cast integrally with the topslide itself, and this is used to provide ■ movable fulcrum for operating the slide. The fixed fulcrum for the long operating lever is obtained by bolting a block to one of the cross-slide T-slots, so that ■ wide range of adjustment is possible. The four-tool turret normally used with the lathe is secured by means of ■ clamp handle engaging a ½-in. Whitworth stud screwed into the toolpost; after the turret has been removed, this stud forms the movable fulcrum for the operating lever, which is drilled with ■ ½ in. diameter bearing hole to correspond.

The Operating Lever—(A)

A length of ¾ in. × ⅜ in. flat, mild-steel will serve for the lever; but if this is not available, two shorter lengths can be tongued and slotted and then brazed together, ■ in the present instance. It is important to make the lever long enough, for if the leverage is insufficient, difficulty may be found in traversing the tool smoothly over the work, as well as in controlling it when the end of the cut is reached. The further end of the lever is slotted to slide on ■ bush secured to the fixed pivot, but a long slot is unnecessary, as only ■ short stroke is generally required.

The rubber hand-grip fitted to the lever is ■ motor-cycle accessory, but ■ smooth, plastic handle would probably be more comfortable to use.

The Movable Fulcrum Stud

This forms part of the lathe, when a turret

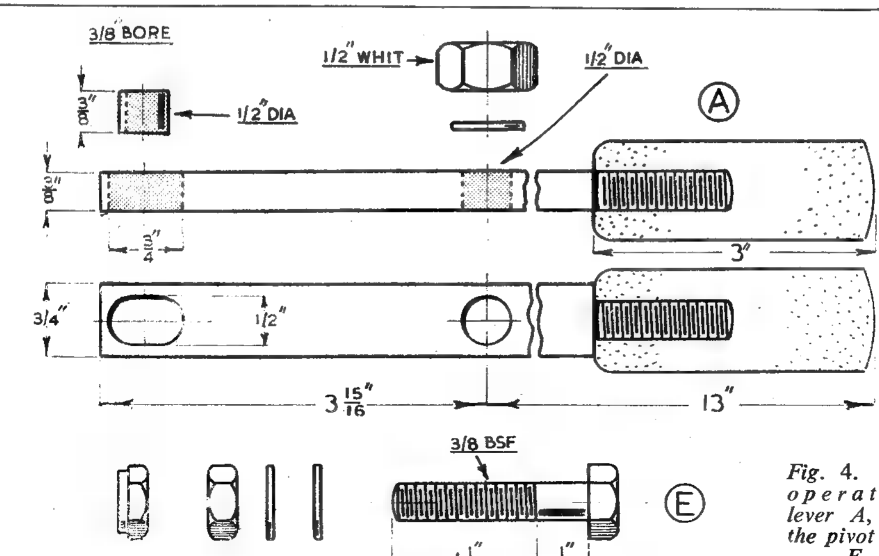


Fig. 4. The operating lever A, and the pivot bolt E

is fitted, and need not be specially made. But should [redacted] stud have to be fitted, it will be found that the toolpost pillar is already tapped ½-in. Whitworth. The addition of [redacted] ½ in. Whitworth nut and washer is then all that is necessary for holding the operating lever in place.

The Fulcrum Block—(B)

The fulcrum block illustrated is the raising block normally used for mounting the vertical-

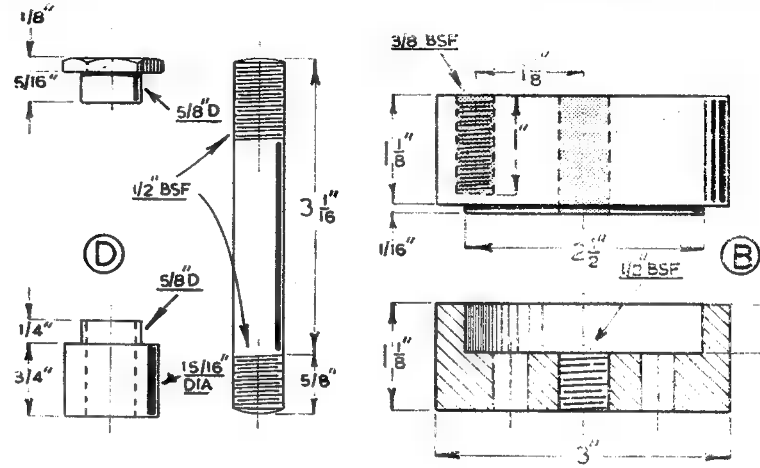


Fig. 5. The two parts of the fulcrum block B, and its clamping bolt and collar D

slide on the lathe cross-slide. This fitting, like some of the others employed, was utilised to [redacted] making new parts, but the actual form of construction is immaterial, [redacted] long as the position of the fixed fulcrum has [redacted] sufficient range of movement for bringing the tool opposite to the work and, at the same time, giving the required length of stroke. The block in question consists of two parts machined from pulley castings; the lower is secured to the cross-slide T-slot by means of the T-strip *C*, furnished with two studs. The lower block is, first, secured in place and the upper is then put on and located by the register shoulder.

After the necessary adjustment has been made, the two blocks are locked together by means of the central clamp-bolt *D* with its spacing collar and shouldered clamp-nut. It will be clear that the upper block is free to rotate on the lower, for the purpose of altering the position of the fulcrum centre.

With the particular block used, both the spacing collar and the clamp-nut had to be shouldered down to allow the projecting end of the operating lever to clear; but if [redacted] larger block is used, to give wider spacing of the bolt centres, [redacted] plain nut and collar will serve.

The Fixed Fulcrum—(E)

This consists of [redacted] ⅜-in. B.S.F. bolt, screwing into the upper block and locked in place by [redacted] of the lower nut shown in the drawing and in the photograph of the assembly. This pivot bolt is fitted with [redacted] bush which is clamped in place between two washers by the upper nut. The slotted end of the operating lever slides on this bush, and [redacted] small end-clearance should, therefore, be allowed to give free-working.

Assembling the Attachment on the Lathe

Remove the top-slide keep-plate and feed-screw, and see that the slide itself is correctly adjusted. The pivot bolt *E* with its bush is then fitted to the lever, and the bush is firmly secured by tightening the clamp-nut, the bolt should then be free both to turn and to slide in the lever slot. Next, secure the base of the pivot block to the cross-slide, but leave the upper part free to turn on the central bolt. Place the lever on the toolpost stud, and screw the pivot bolt *E* into the block until the lever lies horizontally; then secure the pivot bolt by tightening its lock-nut, and fit the nut and washer to the toolpost stud.

The lever will now actuate the top-slide, but the position of the fixed fulcrum may have to be altered to obtain the required length of stroke, and to bring the lever approximately square with

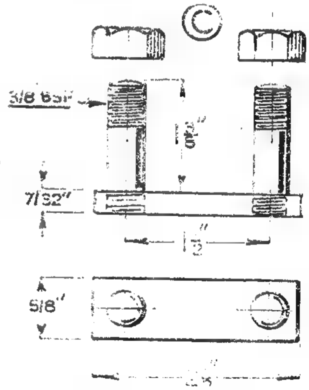


Fig. 6. The double T-bolt for securing the fulcrum block to the cross-slide

the lathe axis when in the mid position. This adjustment can usually be made by merely rotating the upper fulcrum block and then tightening the central clamp-bolt. A form of work-stop can also be obtained, in this way, by adjusting the position of the fulcrum so that the lever bush meets the end of its slot at the finish of the stroke.

If the correct working position cannot be obtained by rotating the block, it will be necessary to lift off the lever, with the upper block attached, to adjust the position of the base on the cross-slide.

"Talking about Steam——"

by W. J. Hughes

A series of articles intended to supply suggestions and information for the would-be "modeller in steam" who has not the time, the inclination or the opportunity for extensive research

7—*Two Self-Contained Vertical Engines

IN the last article, I promised to deal with two or three rather out-of-the-ordinary vertical engines, but I think that there will only be room for two, if we are to finish with another "Tyros' Corner."

Both these engines were exhibited at the Vienna Exhibition of 1873, and I am indebted again to Mr. John L. French for the illustrations, which he sent along with quite a batch of others from the official catalogue of that exhibition.

**Continued from page* 820 THE MODEL ENGINEER *June 26th,* 1952.

A Davey, Paxman Engine

Fig. 28 gives two elevations of an engine built by Davey, Paxman and Co. of Colchester. The stroke is 12-in., and the bore about 8 in., so that a $1\frac{1}{2}$-in. scale model of the prototype would be a nice size, yet not too bulky. Height to the top of the boiler would be about 13 in., and the flywheel would be $7\frac{1}{2}$ in. diameter—not too large for the average model engineer's lathe!

As will be seen, the engine itself is mounted slightly obliquely on the side of the vertical boiler, and in general detail it follows portable engine practice. The crosshead is guided by

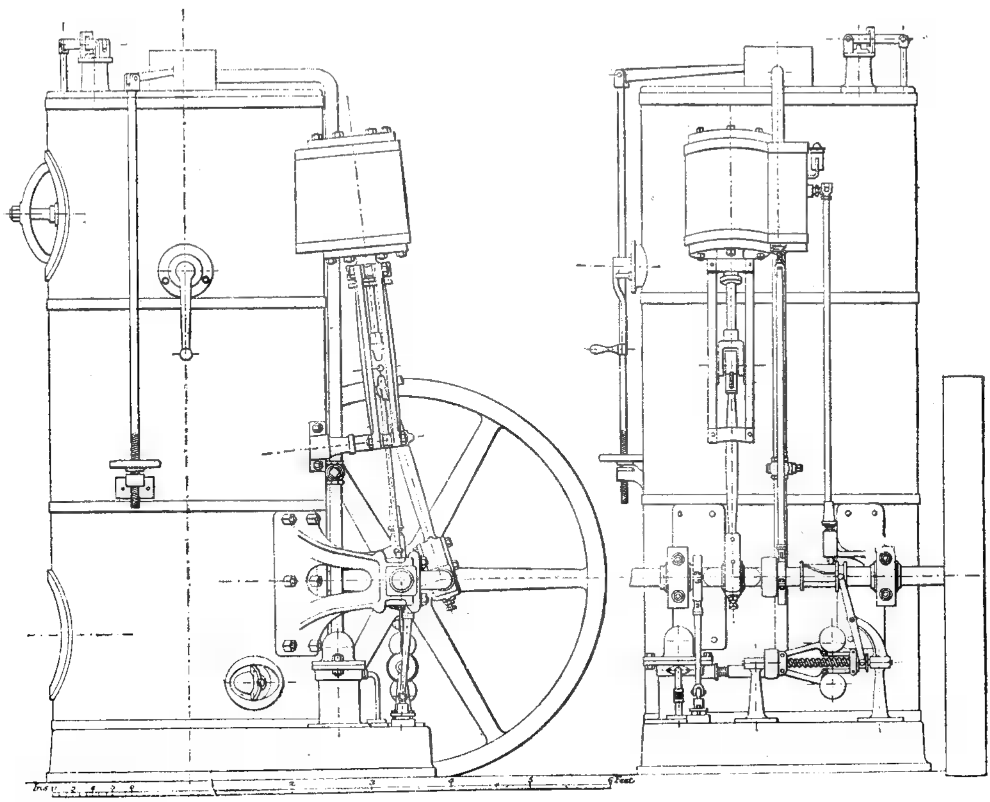


Fig. 28. *Two elevations of a vertical engine and boiler shown by Davey, Paxman & Co. at the Vienna Exhibition of* 1873

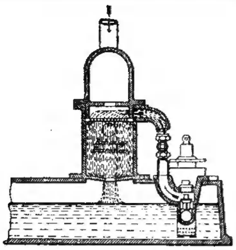
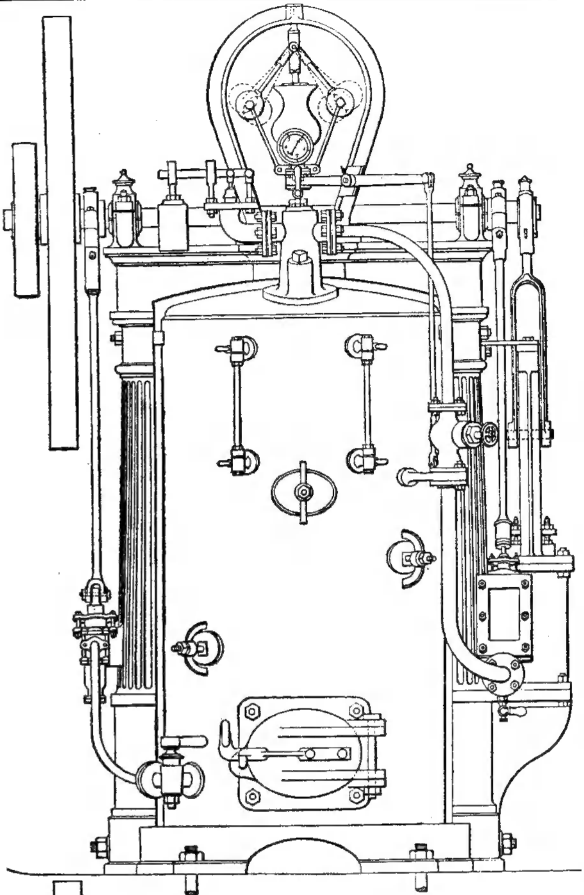


Fig. 29. Arrangement for heating the feedwater

Fig. 31. Right : Elevation of a vertical engine shown by a German firm—full name in the text !—at the Vienna Exhibition



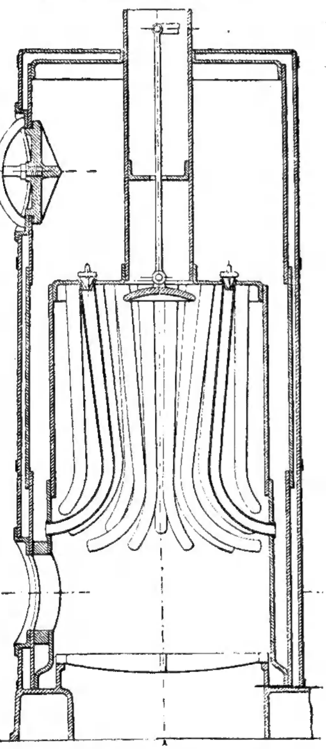
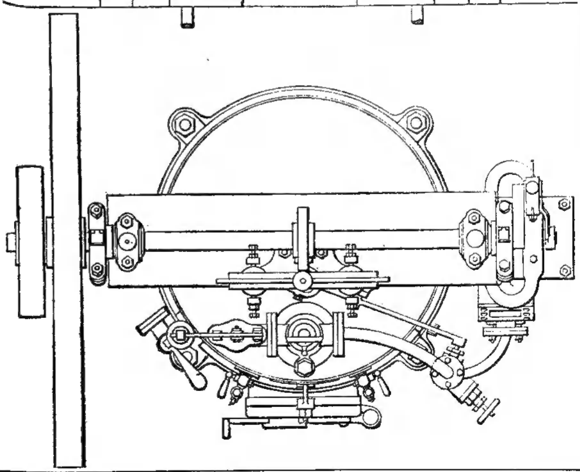


Fig. 30. Cross-section through the Davey-Paxman boiler, showing the unusual arrangement of tubes

Fig. 32. Right : Plan of the engine shown in Fig. 31



four slide-bars, the outer ends of which are supported by a cast bracket bolted to the boiler shell.

The crankshaft, forged from round bar, runs in split brasses carried in two cast-iron brackets, which also are saddled and bolted to the boiler. A fixed single eccentric drives a normal slide-valve, and beside it a pulley drives the governor, mounted in separate brackets fixed to the cast baseplate, which is also a water tank.

Exhaust Feed-Heater

Another eccentric drives the feed-pump, which is sunk into the base-tank, and Fig. 29 shows the arrangement whereby part of the exhaust may be used to heat water from the pump by-pass. Apparently there is a two-way fitting behind the valve-chest; one branch of the exhaust goes direct to the blast-nozzle in the base of the chimney, with the other going (with a stop-valve interposed) to the heating chamber against the pump.

From here the heated by-pass water falls back into the tank, and thence is pumped to the boiler itself.

The Boiler

The boiler is lagged, with a cleading sheet secured by the usual bands over the lagging. Fig. 30 gives a cross-section through the boiler, with its curved water-tubes, and it will be noticed that the boiler top is lagged, too.

In a model, of course, this arrangement of tubes would not be used—there could be ordinary cross water-tubes, or vertical fire-tubes, without altering the outward appearance at all.

The regulator-handle is fixed fairly low down on the boiler, and one assumes that the regulator itself would be high up inside the boiler, worked by a rod from a crank on the handle, and delivering steam to the cylinder through an internal pipe. A hand-wheel nearby regulates the damper at the base of the chimney.

A Salter-type safety-valve would appear to be fitted, but the spring-balance is hidden in both elevations, and it is just possible that there are weights suspended from the lever, instead. Personally I should plump for the Salter-type.

An Engine from Germany

The other self-contained engine and boiler unit was built in Dresden by the Sachsische Dampschiffs and Maschinenbau Anstalt—yes, quite a mouthful, I agree!

In this machine, of which Figs. 31 and 32 are the elevation and plan, the engine is inverted, with the crankshaft brackets mounted on a narrow table over the boiler.

The table is supported by the two fluted half-columns, which are bolted firmly to the cast base, and further steadied at the top by bolts to the boiler shell.

Supported by a bracket cast in one with the right-hand column, the cylinder drives up to an over-hung crank. Note that the crosshead is guided by two cast slide-bars, the upper ends of which are braced by an O-shaped bracket bolted to the column. The connecting-rod is forked to clear this bracket, of course.

It will be seen that the valve-chest is mounted at a slight angle on the side of the cylinder casting, steam being taken to it by a curved pipe from the turret on top of the boiler. A screw-down stop-valve incorporates the governor-valve in the same body, and is supported on a bracket bolted to the boiler.

A weighted safety-valve is also fitted to the turret, and a pressure-gauge surmounts it. There is also a screwed plug in the turret-front which was for use in filling the boiler, and in washing it out.

And talking of the former, the boiler feed-pump is bolted to a little bracket cast on the left-hand column, feeding to a check-valve near the foundation-ring.

Interesting Models

Each of these installations would make an interesting and out-of-the-ordinary model, either purely for exhibition or for running. There would be no particularly difficult problems in the building; probably the worst would be lining up the engine in the Davey, Paxman layout, but even that would not be insuperable.

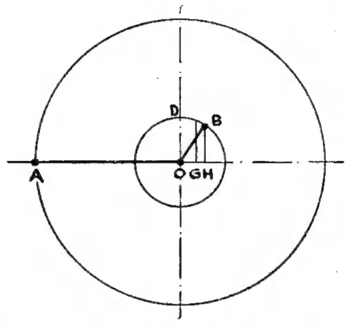


Fig. 33. Diagram of crank and eccentric, to show lap and lead. OG = lap; GH = lead. Compare with Fig. 27 (June 26th issue)

Meantime, here are a couple of teasers for those who like intellectual exercise! First, what are the flue arrangements of the German boiler, and secondly, where does the exhaust steam go? There are *no* prizes for the answers!

Tyros' Corner

In the last article, we dealt with the term "lap," and it will be recalled that in order to use the expansive power of the steam, it was necessary to add to the length of the slide-valve at each end, and to advance the eccentric by the amount of the added "lap." Those tyros who haven't retained the details clearly in their minds are advised to look them up again—June 26th issue—before carrying on with the following.

Lead

Up to now, the valve is arranged to admit steam to the cylinder at the moment that the piston is at either end of its stroke. But the piston, crosshead, and connecting-rod are heavy, and the sudden reversal of the motion of these parts, (twice for every revolution of the engine, remember!) would give very undesirable stresses and strains on the bearings, as well as on the moving parts.

But if steam is admitted to the cylinder a little *before* the piston reaches the end of its stroke, then that steam will act as an elastic spring or buffer in checking the momentum of the moving parts. This is done quite easily by advancing the eccentric a little *more* in relation to the crank, as seen diagrammatically in Fig. 33, in which *GH* is the amount of the "lead" given to the valve. Note particularly that lead involves no structural alteration to the valve itself, but only a further increase in the angular advance of the eccentric. Furthermore, the length of travel of the valve is unaffected by lead.

(To be continued)

PRACTICAL LETTERS

Mr. Turpin's Universal Dividing Head

DEAR SIR,—I have just completed one of the above workshop appliances, and what a champion gadget it is!

It looks fine, and a good sturdy job it proved to be. It has been a source of delight in following Mr. Turpin's instructions, which I have done mostly, except in making the feed nut!

I got my castings from one of your advertisers, and they proved to be satisfactory, easy to machine and pleasing in finish.

I varied Mr. Turpin's design a little, inasmuch as the index for the spindle housing (or directing head) was put on the carriage, the reason being that I would not have to divide out the vice or another attachment in degrees, the one division sufficing.

I have a slotted plate similar to the cross-slide of my lathe and this makes a good table to get on the vertical slide, and, also, to mount the head on when not in use.

Congratulations, Mr. Turpin, I'll see if I can make the polisher you have designed, if I can find room in my workshop.

Yours faithfully,

Manchester. F. J. HAYNES.

Sharpening Twist Drills

DEAR SIR,—I was interested to see the letter from Mr. Lines in "Practical Letters."

For the last 25 years or so I have managed, more or less successfully, to grind small drills without a jig. Dealing with drills below No. 60, however, is a problem which faced me recently, so I spent *not more than* two hours and made the jig described by "Inchometer" (October 25th, 1934) and also recently in a "Practical Letter," March 9th, 1950.

This' little tool gives excellent results down to No. 80—which is the smallest I have used, but no doubt it would be satisfactory on even smaller ones.

I was so pleased with the results of this jig that I promptly made a similar one to that described by Mr. S. F. Weston (May 22nd, 1952). This, of course, is used for larger drills—3/32 in. upwards.

Mr. Lines may say quite correctly, that neither of these jigs grind drills as the makers grind them, but my experience is that both are thoroughly practical simple tools and grind drills that cut accurately and well.

Yours faithfully,

Stoke-on-Trent. O. L. MASSEY.

DEAR SIR,—I should be sorry if the letter from Mr. G. Lines in your issue of the 19th June deterred any reader from making the twist drill grinding jig recently described by "Duplex." By all means learn to sharpen drills by hand as he advises—this is a necessity. There are many occasions, however, where a hole is required dead on size and I must confess that I find it extremely difficult to judge the centre of a drill by eye and at the same time get the angles and the back off equal.

True, I have done without a jig for over 50 years as a model and professional engineer, but many times I wished for such a jig. The point of view depends on what one requires from a drill. Much of my work demands holes dead on size, particularly in the 1 to 60 range, so I decided to make the jig in an attempt to cut out the trial and error tests necessitated by my hand grinding. With this jig, I have no difficulty in grinding drills ranging from $\frac{1}{2}$ in. to No. 72 (0.025 in.) diameter. All the drills produce holes practically dead on size. It was necessary to make a shorter and shallower front drill rest for drills approximately No. 50 and smaller.

Tests were made on sets of drills $\frac{1}{2}$ in. to $\frac{1}{16}$ in. by thirty-seconds, Nos. 1 to 60 and a few odd ones 61 to 72 6 mm. by tenths of a mm. Results were consistently good throughout.

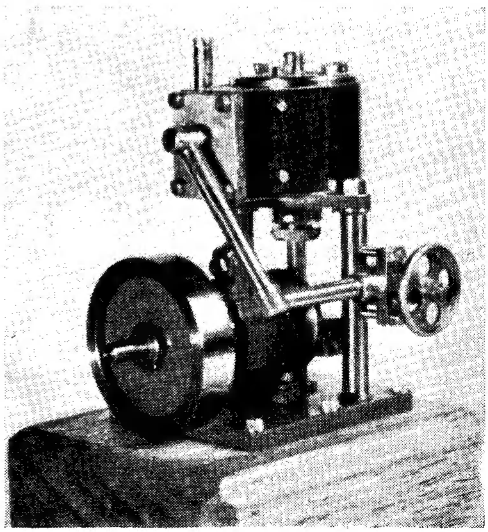
Apart from the assistance that the jig has given me, surely any development relating to tools is of interest to the model engineer. He has to cope with a wide range of operations and make-shifts, and anything which "greases the wheels" is all to the good.

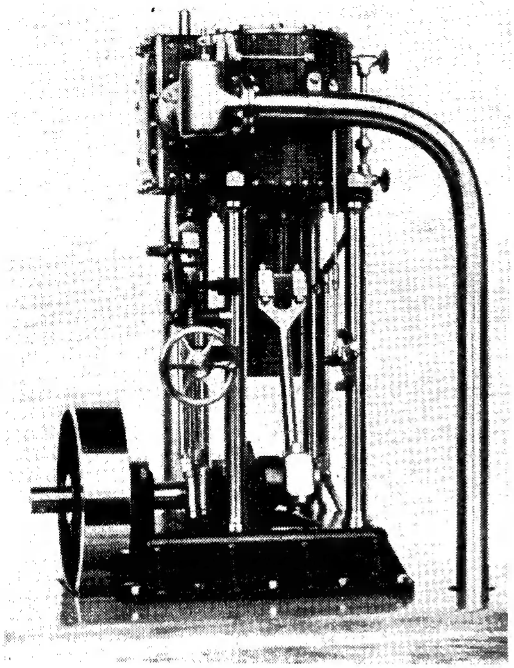
Yours faithfully,

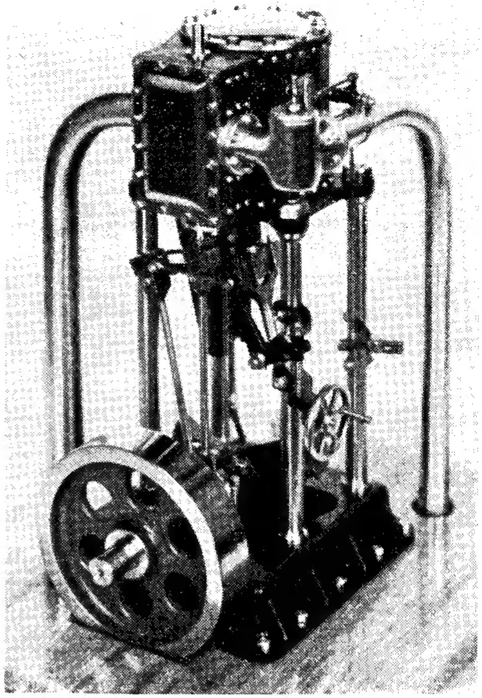
Kingsbury. H. H. GROVES.

An American Reader's Models

DEAR SIR,—For some time I have been reading copies of THE MODEL ENGINEER which I have borrowed from an acquaintance. I have enjoyed these magazines greatly, especially the articles by "L.B.S.C." on steam locomotives. From the pictures and descriptions of models, it appears that your readers do very beautiful







and painstaking model work and it is good to see that some people still enjoy and appreciate good craftsmanship in spite of the rush and bustle of the present-day world.

Some details of my own activities may, therefore, be considered of interest. My first model steam engine was one of $\frac{5}{16}$ in. bore by $\frac{5}{16}$ in. stroke, with a "Scotch yoke" (slide crank), the overall height being $1\frac{3}{4}$ in. I later designed the engine shown in the other photographs, and constructed it largely from scrap material. As I could not find a suitable flat piece of brass $\frac{1}{2}$ in. thick for the baseplate, I cut a slice endwise from a piece of $1\frac{1}{2}$ in. diameter round brass, which was just equal to the full base width. The webs on the base were milled by means of an end-mill specially made for the job.

The slide valve is of the balanced type and works quite smoothly under pressure. It was originally designed for 66.6 per cent. maximum cut-off, but when the engine was operated on air, I found that admission for almost the full length of the stroke was necessary in order to get the engine to run slowly. With this alteration it can be throttled down to 160 r.p.m. As this was my first attempt to construct Stephenson link motion, I found this a very interesting and instructive exercise.

The engine stands 3 7/32 in. high, base dimensions are $1\frac{1}{2}$ in. by $1\frac{5}{8}$ in., with a bore of $\frac{1}{2}$ in. and a stroke of $\frac{5}{8}$ in. Split bronze bushings are used on the main and connecting-rod bearings, also the wrist-pin. The cylinder lagging is composed of strips of mahogany 3/32 in. wide. Stainless-steel is used for the piston and throttle valve. The cylinder drain valves are made to work, and are connected to 1/32 in. pipes with screwed joints 22 t.p.i.

While the work on this model was rather tedious at times, I am fortunate in having good equipment to work with. The turning was done on a 10 in. South Bend lathe and the milling on an Atlas milling machine. All the bolts and nuts, except the 0.025 in. diameter screws which hold the lagging in place, were made on the former machine, while the latter was used to mill the hexagon heads. The 0.025 in. screws were made on an Atlas 6 in. lathe, and have 224 t.p.i.

Wishing your journal every success.

Yours faithfully,

Santa Cruz, Calif. OSCAR M. HUETER, JR.

Any Suggestions

DEAR SIR,—In reply to Mr. T. L. Norman Gilbert, who asks for advice on the best way of securing the head of a club hammer to the handle.

If a good stout iron wedge is forged and given a slight twist at the thin end while hot, and driven in when cold, it will twist itself in. I have fixed small and heavy hand hammers this way, also club and sledge hammers, and have had no trouble with heads coming off.

Yours faithfully,

Kenilworth. T. JONES.